SMC-TR-96-18

AEROSPACE REPORT NO.
TR-96(1410)-3

Ground Cloud Dispersion Measurements During The Titan IV Mission #K19 (10 July 1995) at Cape Canaveral Air Station

22 March 1996

Assembled by

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Systems Engineering
Space Launch Operations

Prepared for

Launch Programs
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El Segundo, California

This report was submitted by The Aerospace Corporation, El Segundo, CA 90245-4691, under Contract No. F04701-93-C-0094 with the Space and Missile Systems Center, 2430 E. El Segundo Blvd., Los Angeles Air Force Base, CA 90245. It was reviewed and approved for The Aerospace Corporation by N. F. Dowling Systems Director, Environmental Systems, Systems Engineering Directorate.

This report has been reviewed by the Public Affairs Office (PAS) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nationals.

This technical report has been reviewed and is approved for publication. Publication of this report does not constitute Air Force approval of the report's findings or conclusions. It is published only for the exchange and stimulation of ideas.

Rockford J. Reiners

R. Reiners, Maj, USAF
SMC/CLN

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (*Leave blank*)

2. REPORT DATE
22 March 1996

3. REPORT TYPE AND DATES COVERED

4. TITLE AND SUBTITLE
Ground Cloud Dispersion Measurements During The Titan IV Mission #K19 (10 July 1995) at Cape Canaveral Air Station

5. FUNDING NUMBERS
F04701-93-C-0094

6. AUTHOR(S)
Environmental Systems Directorate

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
The Aerospace Corporation
Technology Operations
El Segundo, CA 90245-4691

8. PERFORMING ORGANIZATION REPORT NUMBER
TR-96(1410)-3

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Space and Missile Systems Center
Air Force Materiel Command
2430 E. El Segundo Boulevard
Los Angeles Air Force Base, CA 90245

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
SMC-TR-96-18

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT (*Maximum 200 words*)

Launch plume imagery and ground-level HCl measurement results and meteorological data determined during the launch of a Titan IV vehicle at Cape Canaveral Air Station (CCAS) on 10 July 1995 (mission #K19) are presented. These data will be used to determine the accuracy of the Rocket Exhaust Effluent Diffusion Model (REEDM). The imagery data, recorded from three camera sites, show that the ground cloud blew out to sea with a northeasterly trajectory (222°) consistent with T-1 hour rawinsonde data (215–218°). For this 8:38 EDT (12:38 Zulu time) morning launch, visible and infrared imagers viewed the launch plume against the rising sun. The infrared imagery results were found to be superior to the visible imagery results during most of the #K19 plume tracking since parts of the visible imagery were saturated with scattered sunlight. The imagery data show that the stabilization height of the ground cloud (~1850 m) was twice that predicted by REEDM, as was found for the Titan IV #K23 launch.

Ground-level HCl measurements made by dosimeters placed on the pad's lightning towers and perimeter fence, as well as along Phillips Parkway, also show that the ground-cloud moved to the northeast.

14. SUBJECT TERMS
Toxic launch cloud, Toxic hazard corridors, Atmospheric dispersion models, Launch cloud development and dispersion, Launch cloud imagery, HCl monitoring

15. NUMBER OF PAGES
120

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	

Preface

The Air Force's Space and Missile Systems Center's Launch Programs organization (SMC/CL) is sponsoring the Atmospheric Dispersion Model Validation Program (MVP). This program will determine the accuracy of atmospheric dispersion models such as REEDM in predicting toxic hazard corridors at the launch ranges. This report presents launch cloud dispersion and meteorological measurements performed during the #K19 mission's Titan IV launch at CCAS as part of the MVP effort.

An MVP Integrated Product Team (IPT) has been directing the MVP effort. The IPT was led by Lt J. Schorie (SMC/MEEM) during a period that included the #K19 mission. H. Lundblad of The Aerospace Corporation's Environmental Systems Directorate (ESD) is the IPT's technical manager. G. Loper of Aerospace's Lasers and Optical Physics Department and H. Lundblad coordinated the preparation of this report from material contributed by personnel participating in the launch cloud dispersion measurements during the #K19 mission.

Visible and infrared imagery measurements were made on the launch cloud by R. Abernathy, B. Kasper, M. Tanikawa, R. Klingberg, D. Stone, and J. Valero of Aerospace's Environmental Monitoring and Technology Department (EMTD) and D. Schulthess of Aerospace's Eastern Range Systems Engineering Directorate (ERD) in order to monitor the cloud's growth, stabilization, and trajectory. D. Schulthess coordinated site selection and logistical support with appropriate Range organizations. K. Foster (EMTD) digitized the imagery data for analyses by R. Abernathy. R. Abernathy, B. Kasper, and R. Heidner (EMTD) prepared the report's description of the cloud imagery results.

The ground-level HCl measurement effort was managed by Capt P. Devane of 45th Medical Group Bioenvironmental Engineering Services (45 AMDS/SGPB). The ground-level HCl measurement effort was coordinated by MSgt S. Zeigler of SGPB and D. Schulthess of Aerospace's ERD under the direction of Capt Devane. SGPB and NASA/TVDL personnel deployed and analyzed the HCl dosimeters, respectively. SGPB personnel participating in the effort included TSgt M. Forcier, Sgt E. Everhart, SSgt J. Patrick, Sgt R. Rivera, Amn R. Voight, and Amn M. Barker. Capt Devane coordinated risk assessment predictions with 45 SW/SES from the Range Control Center Bioenvironmental Engineering Services console. Capt Devane relayed launch cloud dispersion model predictions to supporting SGPB and TVDL personnel for optimum sensor deployment prior to launch. NASA TVDL personnel who participated in the effort included D. Lueck (NASA), and from INET, T. Hammond, D. Curran, P. Yocom, B. Meneghelli, M. Springer, T. Hodge, and C. Fogarty. This report includes a summary of ground-level HCl measurement results provided by D. Curran and P. Yocom.

R. Evans of Ensco, Inc.'s Applied Meteorology Unit provided meteorological data determined before and after the launch. These data included measurements of ambient temperature, humidity, and wind speed and direction as a function of time at numerous meteorological towers at various tower elevations as well as rawinsonde data and Doppler data collected at various times. R. Abernathy (EMTD) ran REEDM to obtain the predicted cloud stabilization height and ground-level HCl concentrations for use in this report.

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Executive Summary

This report summarizes the results of visible and infrared imagery measurements of the exhaust cloud produced during the Titan IV #K19 launch from CCAS's Space Launch Complex-41 (SLC-41) on 10 July 1995 at 8:38 EDT (12:38 Zulu time). The report also presents ground-level HCl measurements and rawinsonde, Doppler radar, and meteorological tower data determined at CCAS during mission #K19. These data and similar results from future launches will be used with data from aircraft-based HCl sampling and tracer gas releases to determine the accuracy of atmospheric dispersion models such as REEDM in predicting toxic hazard corridors (THCs) at CCAS and Vandenberg Air Force Base. The THCs assess the risk of exposing the public to HCl exhaust from vehicles using solid propellants or to the accidental release of hydrazine-fuel or nitrogen-tetroxide propellant vapors during launch operations.

Personnel from The Aerospace Corporation successfully tracked the trajectory and time evolution of the Titan IV vehicle's ground cloud following launch with new Titan-IV-dedicated Visible and Infrared Imaging Systems (VIRIS) deployed at three separate camera sites. Both visible and infrared imagery were recorded to compare the performance of infrared imagery, which is primarily intended for use at night launches, with that of visible imagery. For this early morning launch, the infrared imagery results were superior most of the time to the visible imagery results because the VIRIS imagers were pointed to the east (into the rising sun) to track the exhaust cloud's trajectory, and, as a result, parts of the visible imagery were saturated with scattered sunlight.

Winds to the northeast blew the Titan exhaust cloud out to sea. The launch cloud's shape and dimensions changed with time in a complex manner due to asymmetric ejection of the launch cloud from the launch pad's exhaust duct, the rapid rise of the hot ground cloud, and separation of the ground cloud from the higher-altitude launch column. Analysis of the imagery data provides information on the ground cloud's dimensions, trajectory, stabilization time, stabilization height, and speed. These parameters are compared to REEDM predictions using T-1 hour rawinsonde data. The ground cloud's northeast trajectory was consistent with the T-1 hour, rawinsonde-determined wind direction at the ground cloud's stabilization height. The velocity of the stabilized cloud measured by visible and infrared imagery (11.4 and 10.6 m/s, respectively) is only slightly greater than the wind speeds (9.3 to 10.3 m/s between altitudes of 1000 to 2500 m) measured by the T-1 hour rawinsonde. On the other hand, some of the most accurately determined parameters from imagery are found to differ from the REEDM predictions. The ground cloud's stabilization height measured at its center (1774±137 m, as derived from visible imagery, or 1913±68 m, as derived from infrared imagery) is about two times that predicted by REEDM (851 m) using T-1 hour rawinsonde data. The rise time of the ground cloud to its stabilization height (about 7.5 to 9.5 min derived from infrared and visible imagery) is longer than the 6 min predicted by T-1 hour REEDM.

Personnel from the 45th Medical Group Bioenvironmental Engineering (45 AMDS/SGPB) and NASA's Toxic Vapor Detection Laboratory (NASA TVDL) deployed dosimeters to determine ground-level HCl doses. The out-to-sea winds limited the deployment of dosimeters to the near-field

HCl sampling. Dosimeters placed on lightning towers surrounding the pad, each 45 m away, registered large HCl responses (>340 ppm-min). Of other deployed dosimeters, HCl was detected (0.15-4.4 ppm-min doses) only by dosimeters placed on the perimeter fence 180 m away from the pad and on Samuel Phillips Parkway in line with the pad's exhaust duct. The dosimetry data obtained indicates that the ground-level HCl primarily moved to the northeast, consistent with the trajectory of the ground cloud as determined by imagery. REEDM predicted that the maximum ground-level HCl concentration was reached 15 km downwind of the pad. No dosimeters had been deployed at this offshore location to verify this prediction.

1. Introduction

There is a strong need to collect data that can be used to validate the performance of atmospheric dispersion and chemical kinetic models that are currently used or under development for predicting the transport and fate of hazardous species that may be released into the atmosphere during Air Force launch vehicle operations. Launch vehicles that employ solid-propellant rocket motors release ground clouds into the Eastern and Western Range launch areas at Cape Canaveral Air Station (CCAS) and Vandenberg Air Force Base (VAFB), respectively, that contain large amounts of hydrogen chloride (HCl). Large quantities of hazardous hydrazine fuels or the oxidizer nitrogen tetroxide could also be accidentally released at the ranges during propellant transfer operations or due to a launch vehicle explosion.

The Air Force launch range safety organizations of the 45th Space Wing at Patrick Air Force Base (45 SPW/SE) and 30th Space Wing at VAFB (30 SPW/SE) are respectively responsible for assuring that Eastern and Western Range launches are carried out only when meteorological conditions are such that personnel in communities nearby CCAS and VAFB cannot be exposed to hazardous levels of HCl, the hydrazine fuels, or N_2O_4/NO_2. Predictions of toxic hazard corridors (THCs) that extend into public areas can lead to costly launch delays. The present use of non-validated models requires the use of conservative launch criteria. The development and validation of accurate atmospheric dispersion models is expected to increase launch opportunities and significantly reduce launch costs. The Space and Missile Systems Center's Titan System Program Office (SMC/ME), now merged into Launch Programs (SMC/CL), thus established the Atmospheric Dispersion Model Validation Program (MVP). MVP is collecting data to determine the accuracy of current and future atmospheric dispersion and chemical kinetic models in predicting THCs during launches of Titan and other vehicles at CCAS and VAFB.

The MVP effort involves the collection of data during Titan launches at CCAS and VAFB to characterize HCl launch cloud rise, growth, and stabilization, as well as launch cloud transport and diffusion. These data, as well as data from tracer gas releases, will, in particular, be used to determine the capability of the Rocket Exhaust Effluent Diffusion Model (REEDM) for predicting THCs at the launch ranges. REEDM (see Appendix A) is used at CCAS and VAFB to predict the locations of THCs in support of launch operations. It is applied to large heated sources of toxic air emissions such as nominal launches, catastrophic failure fireballs, and inadvertent ignitions of solid rocket motors. It uses launch vehicle and meteorological data to generate ground-level concentration isopleths of HCl, hydrazine fuels, NO_2, and other toxic launch emissions. Launch holds may occur when REEDM toxic concentration predictions exceed adopted exposure standards. REEDM is a unique and complex model based on relatively simple modeling physics. It has a long developmental history with the Air Force and NASA, but has never been fully validated. A recent change in toxic exposure standards adopted by the range safety offices has resulted in longer REEDM THCs and a higher potential for launch holds. As a result, validation of REEDM has been identified as a range safety priority.

The MVP has been organized and is being directed by the MVP Integrated Product Team (IPT). SMC/CL is serving as the IPT leader, while the Aerospace Corporation's Environmental Systems Directorate is the IPT technical manager. The IPT consists of personnel with expertise in atmospheric dispersion modeling, meteorology, and atmospheric concentration field measurements. MVP participants include personnel from 30 and 45 SPW (and their contractors), SMC, The Aerospace Corporation, NASA, and NOAA. Key functions include program planning, field data collection, data review and compilation, range coordination, and model validation (see Appendix B).

This report presents the results of measurements performed at CCAS during the launch of a Titan IV vehicle on 10 July 1995 (mission #K19). Visual and infrared imagery measurements were made to monitor the growth, stabilization, and trajectory of the launch cloud. During this launch, measurements were also made of ground-level HCl doses at selected locations near the launch pad. The imagery and ground-level HCl measurement results are presented in Sections 2 and 3, respectively. REEDM predictions of ground cloud stabilization heights and surface concentrations are shown in Appendix C. Meteorological data, measured at a number of CCAS monitoring locations prior to launch and during development and dispersion of the launch cloud, are tabulated in Appendix D.

The imagery data obtained show that, for the meteorological conditions present during the #K19 launch, REEDM underestimated the cloud's stabilization height and stabilization time. A plume trajectory (222°) is determined from the imagery data that is within the range of the recorded wind vectors (215–228°) from the T-1 hour rawinsonde measurements at the stabilized cloud's altitude. Likewise, the imagery-derived velocity (10.6–11.4 m/s) of the cloud along its track is close to the T-1 hour rawinsonde-measured wind velocities (9.3–10.3 m/s) at the cloud's altitude. The results presented in this and subsequent reports will allow the accuracy of REEDM and other launch range atmospheric dispersion models to be determined.

2. Imagery of the Titan IV #K19 Ground Cloud

[The material in this section was contributed by R. N. Abernathy, B. P. Kasper, and R. F. Heidner III of the Environmental Monitoring and Technology Department of The Aerospace Corporation's Space and Environment Technology Center.]

2.1 Background

On 10 July 1995, the Titan #K19 mission was successfully launched from CCAS at 08:38 EDT (12:38 ZULU). This section describes the exhaust cloud imagery data collected by each of three imagery sites during the 14 min immediately following the launch from Space Launch Complex 41 (SLC-41). It also briefly describes the data acquisition hardware and analysis software. The two-dimensional cloud images recorded at each site are combined in a pairwise fashion to produce stereoscopic 3-D information. This analysis yields the cloud rise time, stabilization height, dimensions, and ground track.

This section not only provides an overview of the data collected by the imagery sites, but also correlates the results of the exhaust cloud imagery with rawinsonde measurements and REEDM predictions. This data should be of particular interest to modelers.

The raw visible imagery data are archived on VCR tapes. The selected visible images analyzed for this report as well as all of the infrared imagery are also archived on magneto-optical disks as digital image files.

2.2 Introduction

This section summarizes the results of imagery of the exhaust cloud from the Titan IV #K19 launch from Space Launch Complex-41 (SLC-41) on 10 July 1995 at 8:38 EDT (12:38 ZULU). Aerospace personnel from the Environmental Monitoring and Technology Department (EMTD) supported this launch with the first deployment of three complete platforms of the Titan IV-dedicated Visible and Infrared Imaging System (VIRIS). For the #K19 morning launch, three visible/infrared camera systems were used to record imagery from perspectives that permit postlaunch reconstruction of the ground cloud dimensions and track as a function of time. Since each of these systems included the 8–12 μm IR camera, the launch allowed a direct comparison of the visible and IR image quality. The imagery sites chosen for the #K19 launch were UCS-7 (north-northwest of the SLC-41 complex), SLC-34 blockhouse (south-southeast of the complex), and the Press Site (east-northeast of the complex). These same sites were employed for the earlier launch of Titan IV #K23.

Analysis of the imagery yields the stabilization time, the stabilization height, and the trajectory of the ground cloud without recourse to additional data sources. Rudimentary knowledge of the rawinsonde wind data is needed for more quantitative interpretation of the imagery data. The rawinsonde pre-

launch meteorology data are documented in Appendix D and referenced in this secton. REEDM predictions are documented in Appendix C and referenced in this section.

Atmospheric scatter and optical reflections resulting from the rising sun complicated the visible imagery of the eastern-bound cloud from all three imaging sites without affecting the quality of the infrared imagery from any site. Separate analysis of the visible and infrared imagery independently documented the cloud rise time, the stabilization heights, the cloud trajectory, and the cloud velocity. The imagery results are compared with rawinsonde data collected one hour prior to the launch and REEDM predictions based upon the T-1 hour rawinsonde data. The cloud stabilized at twice the height predicted by REEDM using the T-1 hour rawinsonde data.

2.3 Field Deployment

2.3.1 Planning

The Aerospace Corporation's participants are listed in various subteams below (members of the imaging teams for #K19 are indicated by asterisks):

Technology Operations
- Space and Environment Technology Center
  - Environmental Monitoring and Technology Department

R. N Abernathy*	R. F. Heidner III
B. P. Kasper*	R. A. Klingberg*
J. T. Knudtson	D. K. Stone*
M. S. Tanikawa*	J. T. Valero*

Space Launch Operations
- Systems Engineering Directorate
  - Environmental Systems
    - N. F. Dowling, Systems Director
    - H. L. Lundblad
- Eastern Range
  - Systems Engineering Directorate
    - D. R. Schulthess

2.3.2 Equipment

The equipment at each site included all the hardware and software necessary to record and document the launch, to communicate between sites, and to supply backup power in case of an outage at the fixed power distribution points. The launch of #K19 marked the first opportunity to deploy the Titan IV-dedicated Visible and Infrared Imaging System (VIRIS) hardware using all three IR imaging systems.

The VIRIS consists of an array of three full and one back-up (excluding the IR imager) cloud tracking systems and was designed and fabricated at the request of Space Launch Operations, Systems Engineering Directorate, at The Aerospace Corporation. Each full tracking system consists of coaligned

visible and IR (8–12-μm) imagers, mounted on an azimuth- and elevation-encoding tripod, with an associated data acquisition and display console. The combination of visible and IR imagers permits cloud tracking in both daylight and darkness. The unique capabilities built into the VCR hardware include digital insertion of imager azimuth (Az), elevation (El), time, and GPS location. The system electronics are integrated in a single package, which has been ruggedized for field use. Prewiring of this package makes deployment of these imager systems straightforward, usually requiring less than 45 min for instrumentation at a site to become fully operational.

For the Titan IV #K19 mission, the operators at each site set the field of view (FOV) of the IR imager to its maximum (i.e., 20v° × 40h°) using its standard lens. The apertures on the lens of the visible imagers at all sites were set at their widest value (24v° × 32h°) to allow for the best comparison of the visible and IR imagery.

All three imaging systems deployed for the Titan IV #K19 mission were capable of total autonomy. Differential-ready GPS receivers documented each imager's position with moderate spatial resolution. Typically, 35 m is the precision in the horizontal plane. Gasoline-powered AC generators (Honda Ex1000) provide insurance against loss of fixed power. The Stirling cooler option for the AGEMA 900 series IR imagers was chosen so that liquid nitrogen would not be required at the sites. Each unit was transported in a standard utility wagon (e.g., Ford Explorer).

The Az/El angle encoders for all imager systems were calibrated using reference objects (e.g., SLC-41) within the field of view of the imagers. When reference objects are not part of the geodetic survey database, the GPS location uncertainty is the dominant term in the positional accuracy. Imager pixelation and operator error in edge detection contribute as well to the error in defining the cloud boundary. Step-size in the tripod angle encoders is a third source of error. Typically, the VIRIS system provides 0.1° precision. The accuracy is usually determined by the availability of optimal references for Az/El calibration.

2.4 Processing of Imagery Data

The processing of the imagery data requires several transformations that are performed upon return to The Aerospace Corporation:

1. Digitizing frames of the visible imagery.
2. Measuring the pixel locations of the reference sites within each image (i.e., FOV and angular calibration).
3. Measuring the pixel locations of cloud features in digitized images.
4. Converting pixel locations to azimuth and elevation readings.
5. Calculating cloud characteristics (i.e., position in Cartesian coordinates relative to the launch pad).

The processing requires the use of specialized hardware and software. Visible images of the cloud are digitized at precise times, beginning with time intervals of 15 s, then 30 s, then 1 min as the cloud evolves. Infrared images from the AGEMA 900 imagers are produced initially in digital form every

15 s. Time, Az, and El are tabulated for each digitized image. Two sets of triads of digitized images (one visible set and one IR set) exist for selected times following the launch. A setup file is created for each of these triads, containing all relevant information necessary to compute the cloud geometry. The Aerospace program PLMTRACK is run to digitize the x, y, and z coordinates of cloud features.

PLMTRACK is a software program developed in Aerospace's Environmental Monitoring and Technology Department (EMTD) by Brian P. Kasper. It is designed to analyze pairs of cloud images synchronized in time. The operator selects the location of a particular cloud feature in the images from the two imager sites by moving a screen pointer over the desired point in each image and clicking a mouse button. PLMTRACK then calculates the three-dimensional location of this point and writes the information to a data file.

Another implementation of PLMTRACK is the "box method," illustrated in Figure 1. The operator draws a rectangle about a cloud feature in the images from the two imager sites by moving a screen pointer to the extreme corners of the rectangles and clicking a mouse button. PLMTRACK then calculates the closest approach for various rays as illustrated in Figure 1 and described below. The top of the cloud is defined by rays determining T1 and T2 (i.e., T1 × T2); the bottom is determined by rays defining B1 and B2 (i.e., B1 × B2); and the middle is defined by the geometric mean of top and bottom (i.e., M1 × M2). To define the "sides" of the rectangles, the points of closest approach for ray M1 with L2 and R2 (the left and right tangents to the cloud fromImager 2) are defined (i.e., M1 × L2 and M1 × R2). A similar procedure is used to define the points of closest approach for M2 with L1 and R1, yielding M2 × R1 and M2 × L1. Thus, seven points are defined for the "box" surrounding the cloud (a point in the center of each of the six sides, plus a middle point) and are written to a file.

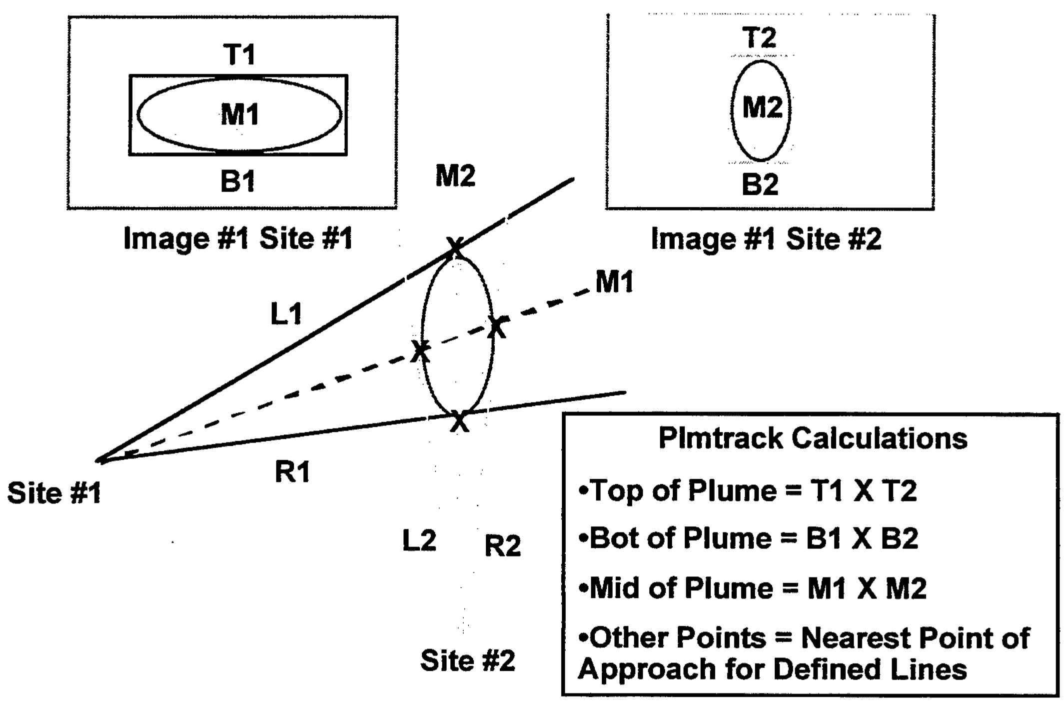


Figure 1. Implementation of the "box" method with two images.

When three imagers are viewing the cloud simultaneously, a six-sided polygon method (documented in Figure 2) has been employed as an initial step in our plan to determine cloud volume as a function of time. With three imagers, there is a triply redundant determination of the top, middle, and bottom of the cloud by PLMTRACK. The horizontal extent of the cloud is determined by defining the rays from each imager that are tangential to the widest part of the cloud as seen from that site. Projection of these extreme rays for each imager on the x-y ground plane forms a six-sided polygon that bounds all material in the cloud at all altitudes, as shown in Figure 2. Thus, one expects to see aircraft HCl sampling "hits" fall within this polygon, regardless of the sampling altitude. When the polygon area is combined with the mean cloud height (i.e., the difference between the top and the bottom) of the cloud, one can obtain an upper bound for cloud volume. This upper bound volume may significantly overestimate the volume of the cloud and has not been used in this report. The utility of the polygon method has been documented in a previous report for the #K23 mission. In that report, the polygons from imagery were correlated with aircraft's HCl measurements of cloud dimensions and average HCl concentrations for the Titan IV #K23 launch cloud. After correcting for Geomet time response, the #K23 data set established that HCl concentrations detectable by an aircraft-based Geomet total HCl detector were mostly contained by the six-sided polygon areas for the first 20 min after launch. Even though no aircraft data were collected during the #K19 mission, the #K23 data established that the imagery-derived position of the visible cloud correlates with the measurable HCl concentrations. The #K19 imagery data documents the correlation of infrared with visible imagery.

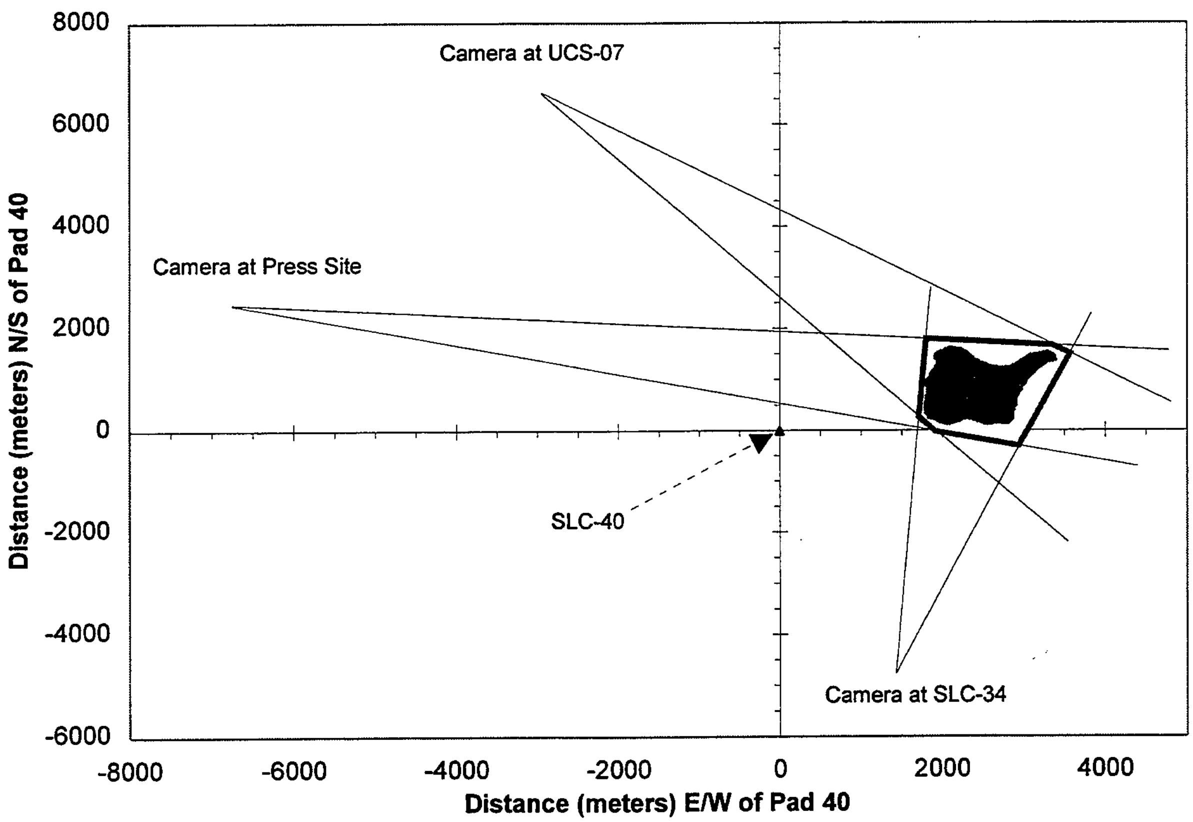


Figure 2. Implementation of the six-sided polygon method for three imagers. The imager positions and rays as well as the cloud's shape were synthesized for heuristic purposes.

2.5 Results and Discussion

2.5.1 Correlation of Ground Cloud Trajectory with Wind Direction

Figure 3 presents the trajectory of the observed ground cloud (i.e., visible imagery and infrared imagery documented cloud tracks consistent with 222° and 221° rawinsonde convention [defined fully in Subsection 2.5.4]). For comparison, Figure 3 presents the trajectories (rawinsonde convention) predicted by REEDM (using the T-1 hour rawinsonde data) for the ground cloud at the surface (cloud maxima along 229° rawinsonde convention) and at the predicted stabilization height (cloud maxima along 242° rawinsonde convention at 851 m). Figure 3 also presents the rawinsonde-derived wind directions associated with the bottom (228° at 1053 m), middle (215° between 1703 and 1824 m), and top (216° at 2434 m) of the stabilized ground cloud (as determined independently by visible and infrared imagery). Lastly, Figure 3 documents the locations of the rawinsonde release site and of the three imager sites (UCS-7, Press Site, and SLC-34) used by Aerospace while imaging the #K19 exhaust cloud.

It is evident from examination of Figure 3 that the low-altitude winds (< 2500 m) were consistent with the imaged movement of the ground cloud into the northeast quadrant relative to the SLC-41 launch pad. It is also evident from Figure 3 that the wind direction shifted only slightly with altitude. This was confirmed by the imagery that documented the movement of the ground cloud into the northeast with little rotation of the top relative to the bottom. The T-1 hour rawinsonde data in Figure 3 are documented in Appendix D.

Figures 4 through 7 are selected visible ("a" portion) and infrared ("b" portion) images of the Titan IV #K19 launch cloud as seen from each of the three imager sites at the specified times after launch. It is immediately obvious that the cloud is not spherically symmetrical in any of these images, and that the geometry of the cloud changes rapidly in the first minutes after launch. Figure 4 documents imagery from UCS-07, which is north-northwest of the launch complex SLC-41. Examination of this image reveals that the exhaust duct produces an asymmetry in the ground cloud by ejecting exhaust predominantly to the East (i.e., to the left in Figure 4) of the pad. The analyst used the top of the exhaust duct cloud as a marker for the top of the ground cloud during the first several minutes after launch. Comparison of the "a" portion to the "b" portion of Figure 4 reveals comparable detection of the ground cloud by visible and infrared imagery from UCS-07. There is evidence of solar scatter in the eastern edge of the visible image (i.e., left edge), which appears overexposed. There is evidence of a background radiance gradient from low elevation to high elevation in the infrared image that results in better contrast at high altitudes against an almost black background. Figure 5 documents imagery from SLC-34, which is south-southeast of launch complex SLC-41. These images document extremely poor signal-to-noise ratio in the visible ("a" portion) due to atmospheric scatter from the rising sun (east is to the right in this perspective). The infrared ("b" portion) documents little difference in the contrast from left to right and, therefore, little effect from the solar illumination angle on the infrared imagery. The strong elevation dependence of the background atmospheric radiance dominates the infrared imagery. Figure 6 documents imagery from the Press Site and illustrates that the optical reflection from the sun complicates detection of the cloud outline in the visible ("a" portion) with no effect in the infrared ("b" portion). The infrared radiance of the cloud remains brighter than both the atmospheric background and the radiance from the launch column at higher altitudes. Figure 7 documents imagery from UCS-07 with the sun in the field of view of both the visible ("a") and infrared ("b") imagery. The detection of the cloud edges is based upon shadows and scatter in the visible and radiance intensity in the infrared. The ground cloud is brighter than the dispersed launch column in the infrared.

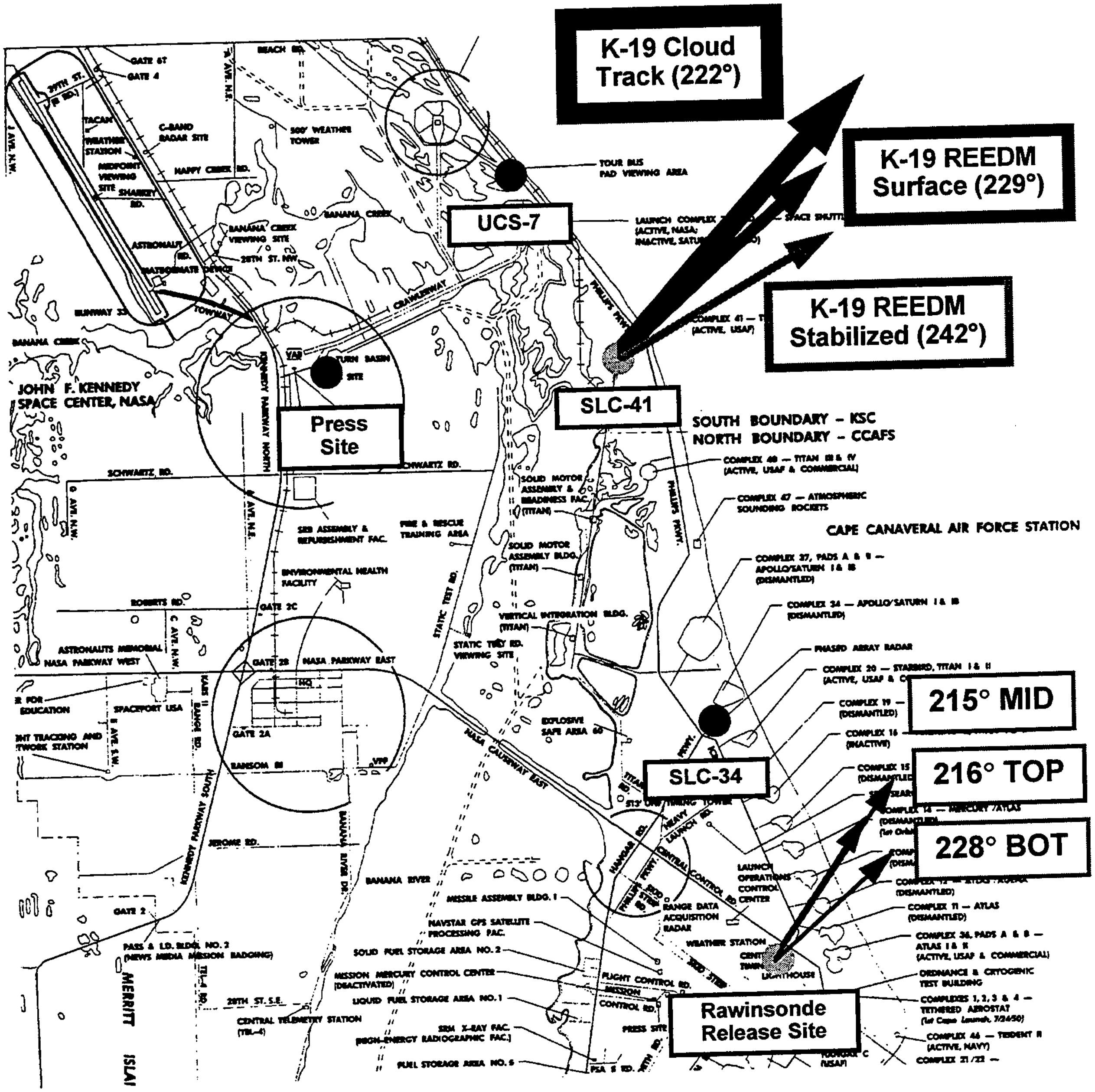
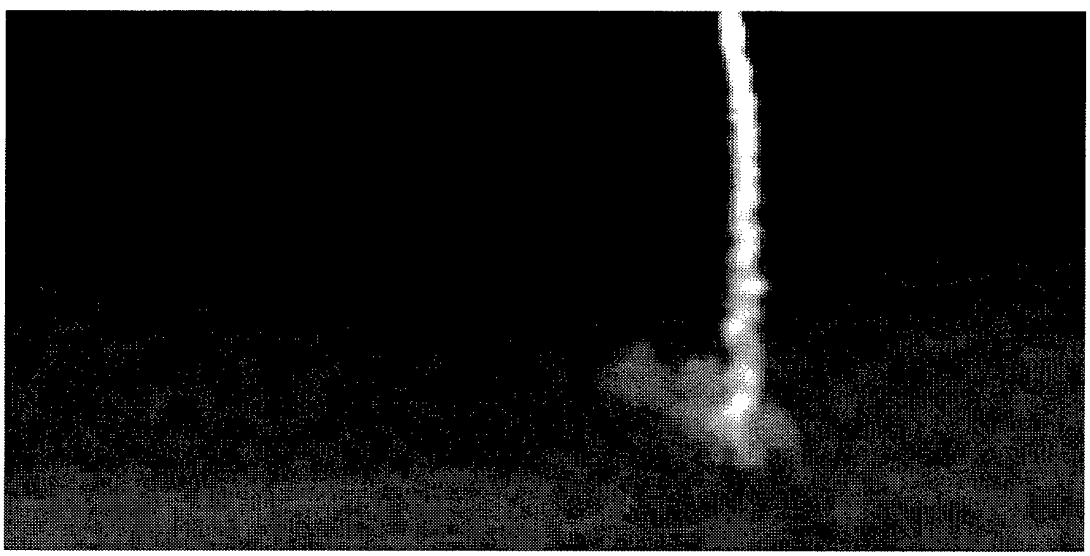


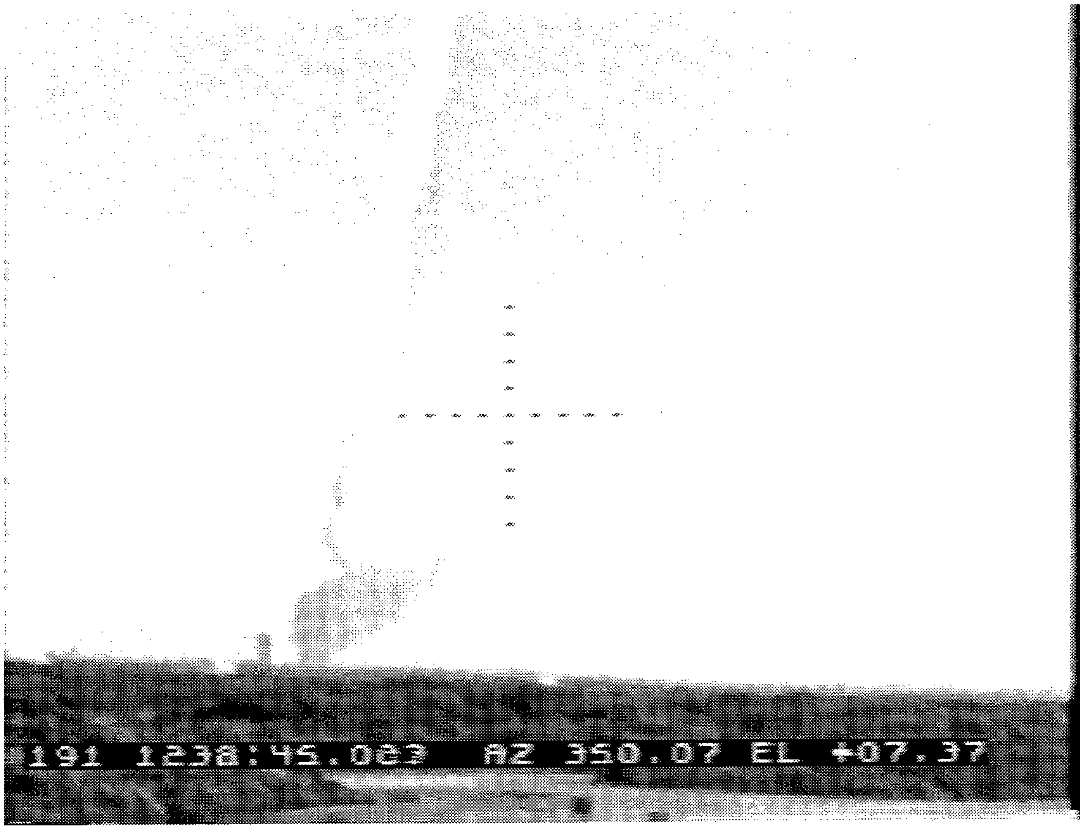
Figure 3. A map documenting the imagery sites, the rawinsonde release site, the #K19 ground cloud's track derived from visible imagery, the T-1 hour REEDM surface and stabilized cloud tracks, and the 11:38 ZULU (T-1 hour) rawinsonde wind vectors at the measured cloud stabilization heights.

(a)

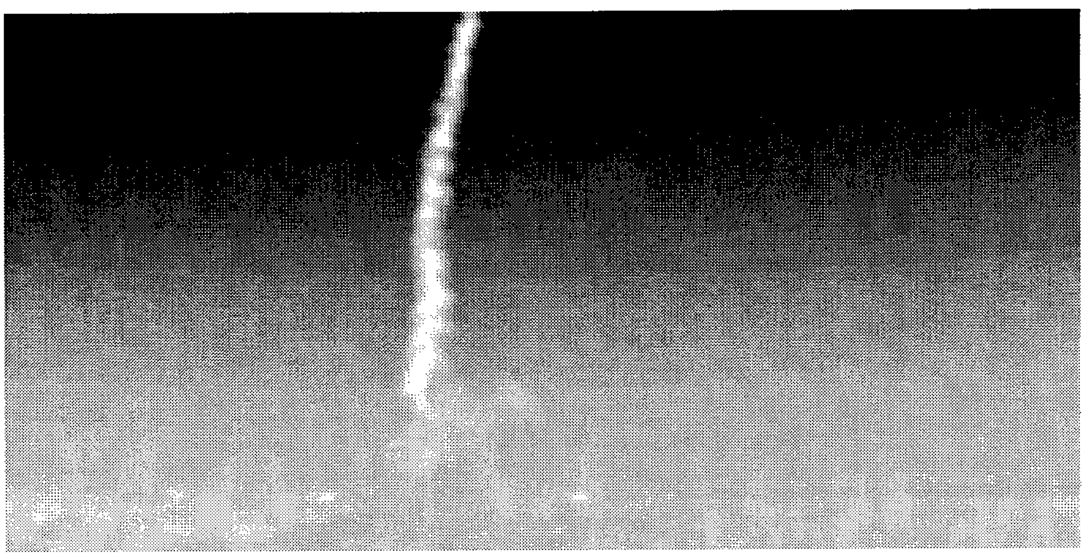


(b)

Figure 4. #K19 launch cloud viewed from UCS-07 blockhouse roof at 00:30 (mm:ss after launch). (a) visible imagery and (b) infrared imagery.

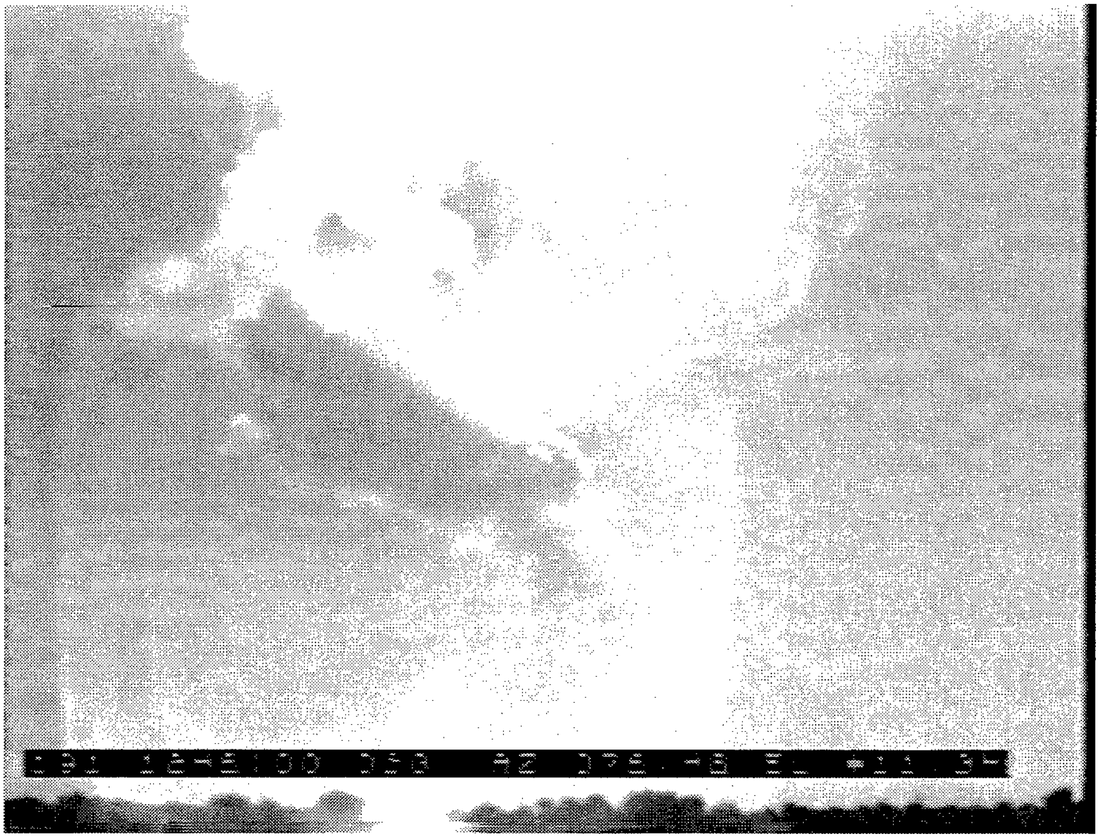


(a)

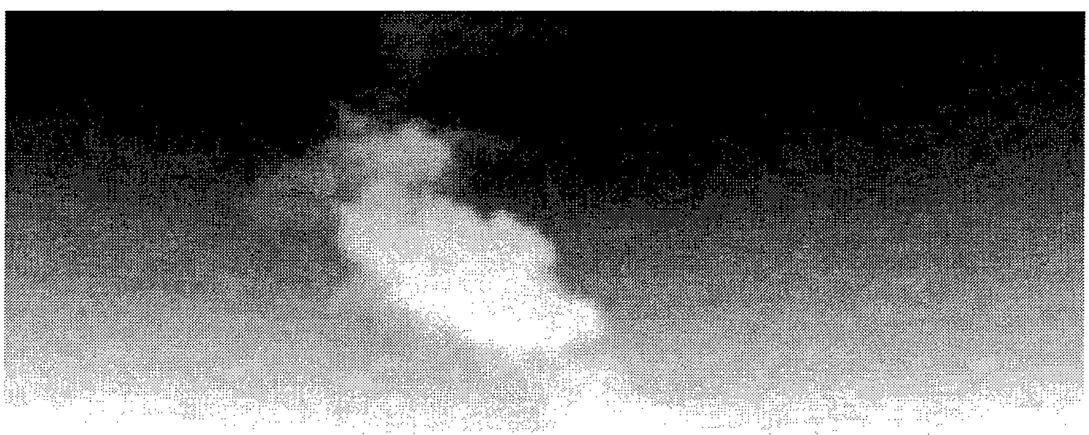


(b)

Figure 5. #K19 launch cloud viewed from SLC-34 site at 00:45 (mm:ss after launch). (a) visible imagery and (b) infrared imagery.

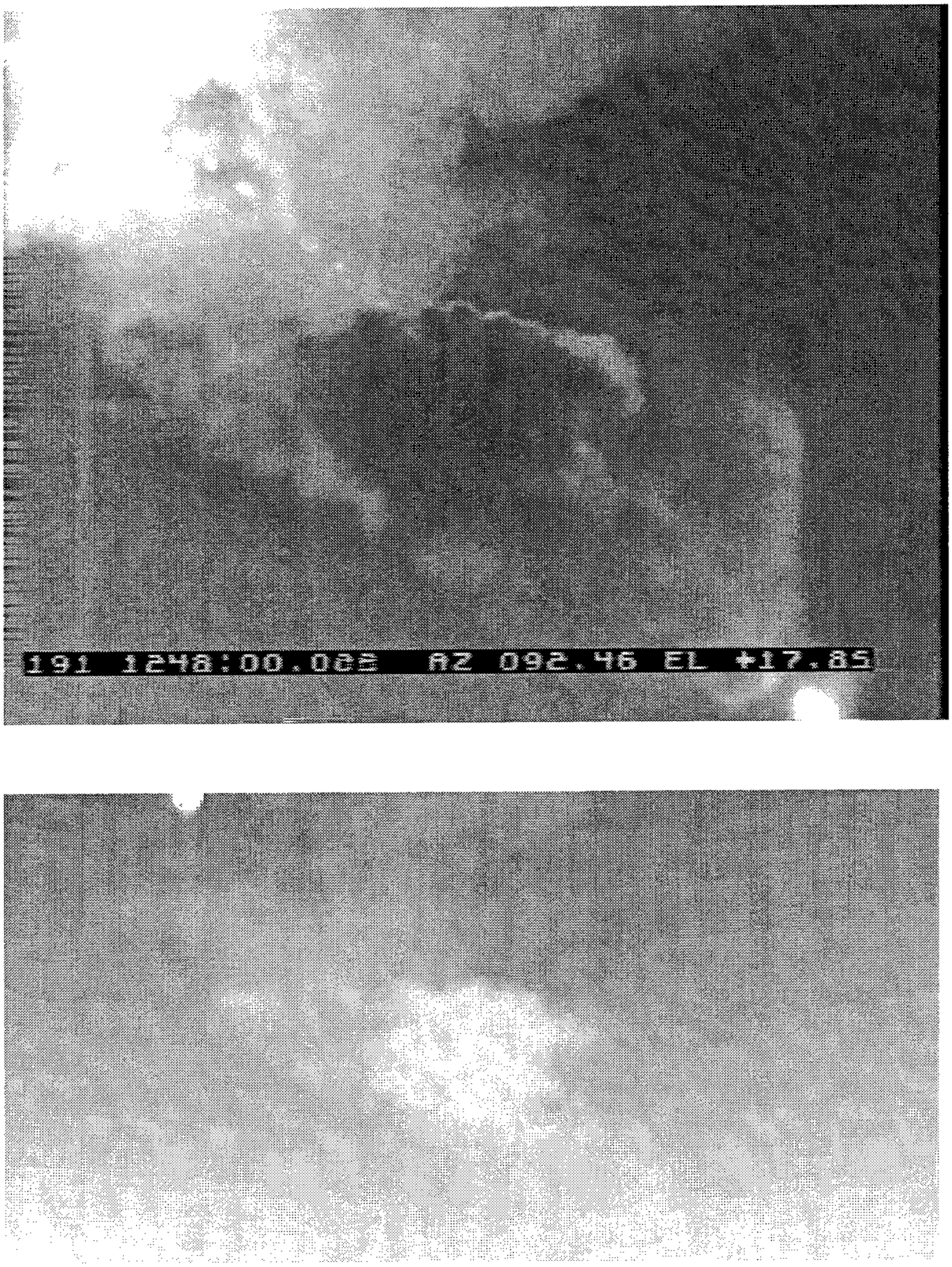


(a)



(b)

Figure 6. #K19 launch cloud viewed from Press Site at 07:00 (mm:ss after launch). (a) visible imagery and (b) infrared imagery.



(a)

(b)

Figure 7. #K19 launch cloud viewed from UCS-10 at 10:00 (mm:ss after launch). (a) visible imagery and (b) infrared imagery.

The imagery data were subjected to an iterative analysis to ensure that only cloud features contributing to the stabilized ground cloud (as documented by the entire 14 min of imagery) were included in the PLMTRACK "boxes." It is also obvious that the visible imagery and the infrared imagery differ in their ability to identify the ground cloud. Due to the early hour and the rising sun, the visible images were badly cluttered with reflections of the sun off the imager optics and from particulates in the atmosphere. The sun was also seen in the infrared image, but did not complicate the image processing. The ability of the IR imager to image the cloud while viewing in the direction of the sun is a major advantage over visible imagery. The IR imager is detecting thermal radiation from the cloud, whereas the visible imager is looking at solar scattering off cloud particulates. As a result, the IR images of the cloud presented a more consistent cloud outline than the visible images as the solar angle changed with time and cloud position.

2.5.2 Cloud Rise Times and Stabilization Heights

A series of plots is presented in Figures 8–13, showing the time-dependent altitude of the "bottom," the "middle," and the "top" of the ground cloud as perceived by visible and infrared imagery. With three imager locations, it is possible to obtain three independent determinations (3!/2) of these cloud heights for visible and infrared imagery. The data are presented in two ways. First, the raw data for height vs time after launch are displayed for each of the three determinations (ucs7 + press, ucs7 + slc34, and slc34 + press). The visible and infrared data are presented separately for the bottom (Figures 8 and 9), the middle (Figures 10 and 11), and the top (Figures 12 and 13). A polynomial fit is generated using the combined data from these three determinations [the (a) portion of Figures 8–13]. For clarity, all data (without distinction with respect to imaging site) and the polynomial fits are displayed with horizontal lines illustrating the stabilization height ±3s error levels [the (b) portion of Figures 8–13].

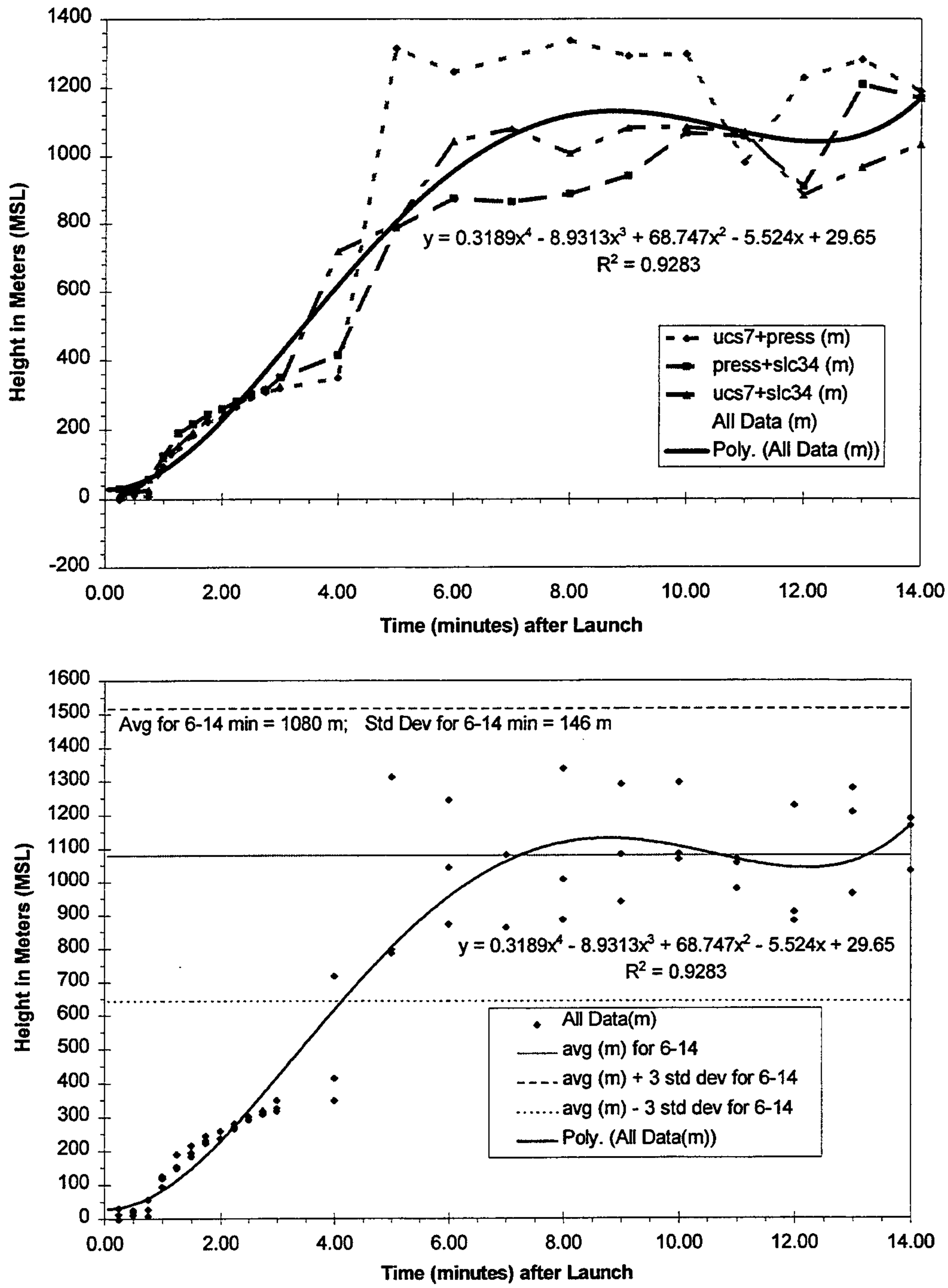
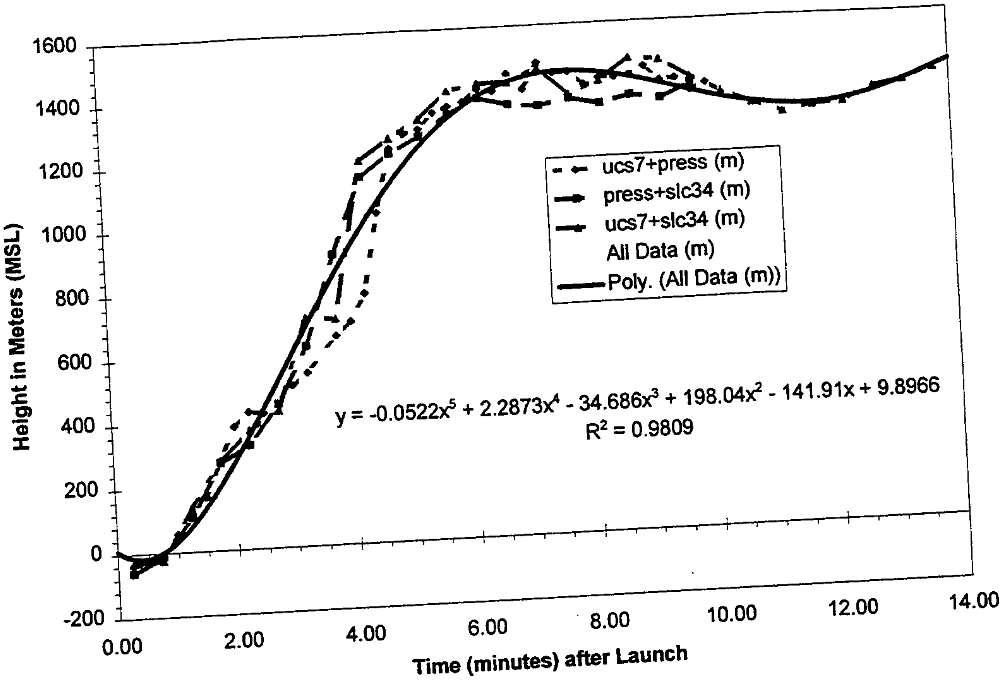


Figure 8. Cloud rise plot for the bottom of the #K19 cloud as determined by visible imagery. (a) Three independent determinations are made from the pairwise combination of data from the three imaging sites. These determinations are labeled as ucs7 + press, press + slc34, and ucs7 + slc34. The fourth-order polynomial fit to the entire set of data is plotted as H(t) vs t (in minutes). The variance (R^2) of 0.9283 indicates the high quality of the fit. (b) All three sets of H(t) vs t data are combined and displayed with the fourth-order polynomial fit and the 3σ error bands for the stabilization height.



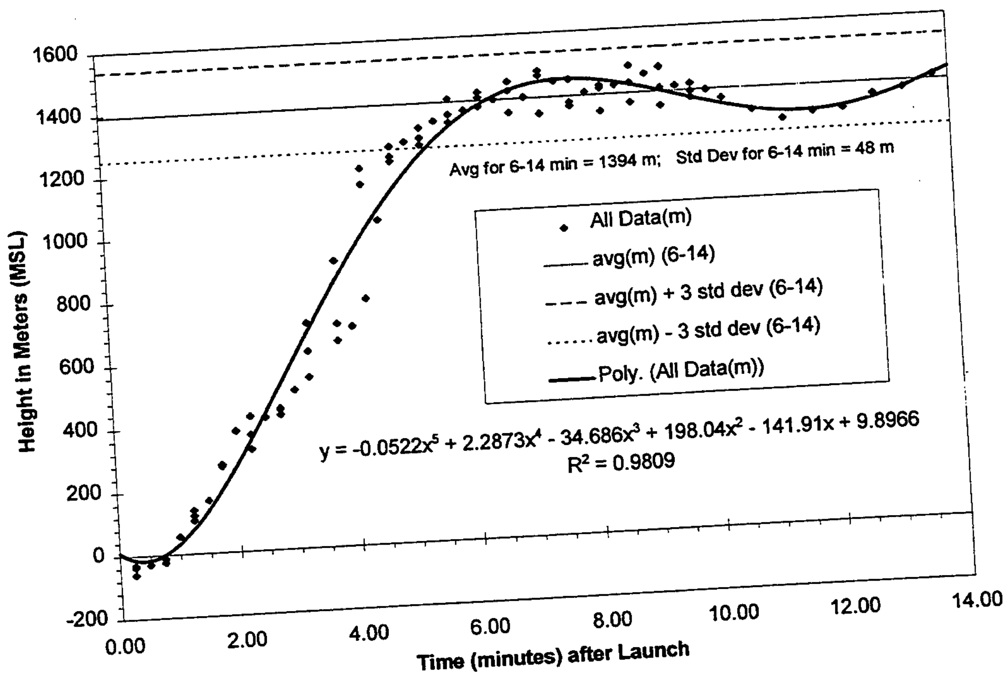
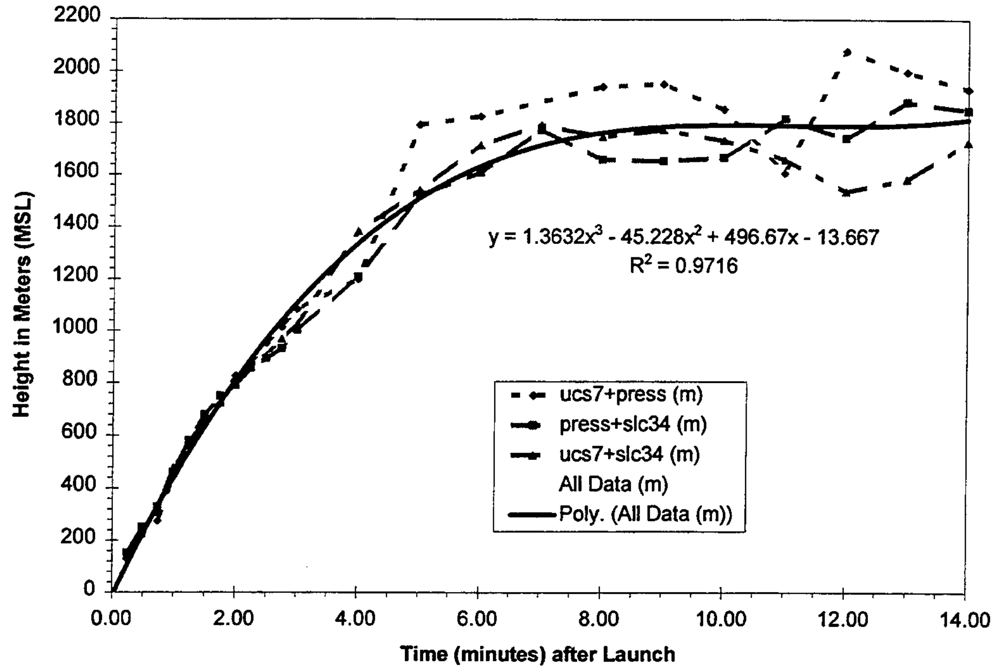


Figure 9. Cloud rise plot for the bottom of the #K19 cloud as determined by infrared imagery. (a) Three independent determinations are made from the pairwise combination of data from the three imaging sites. These determinations are labeled as ucs7 + press, press + slc34, and ucs7 +slc34. The fifth-order polynomial fit to the entire set of data is plotted as H(t) vs t (in minutes). The variance (R^2) of 0.9809 indicates the high quality of the fit. (b) All three sets of H(t) vs t data are combined and displayed with the fifth-order polynomial fit and the 3σ error bands for the stabilization height.



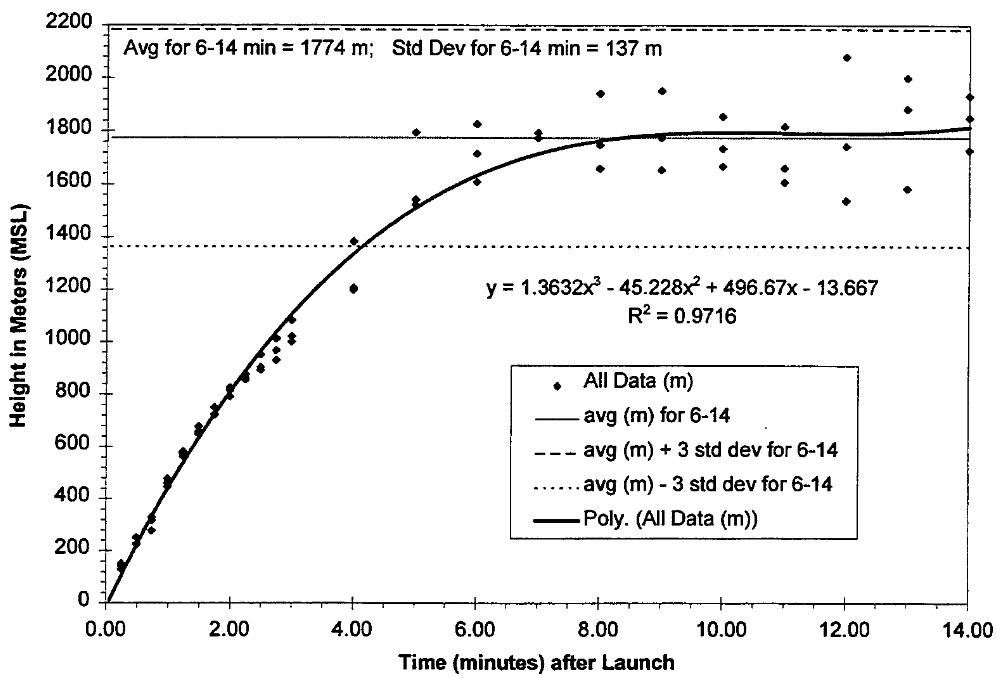
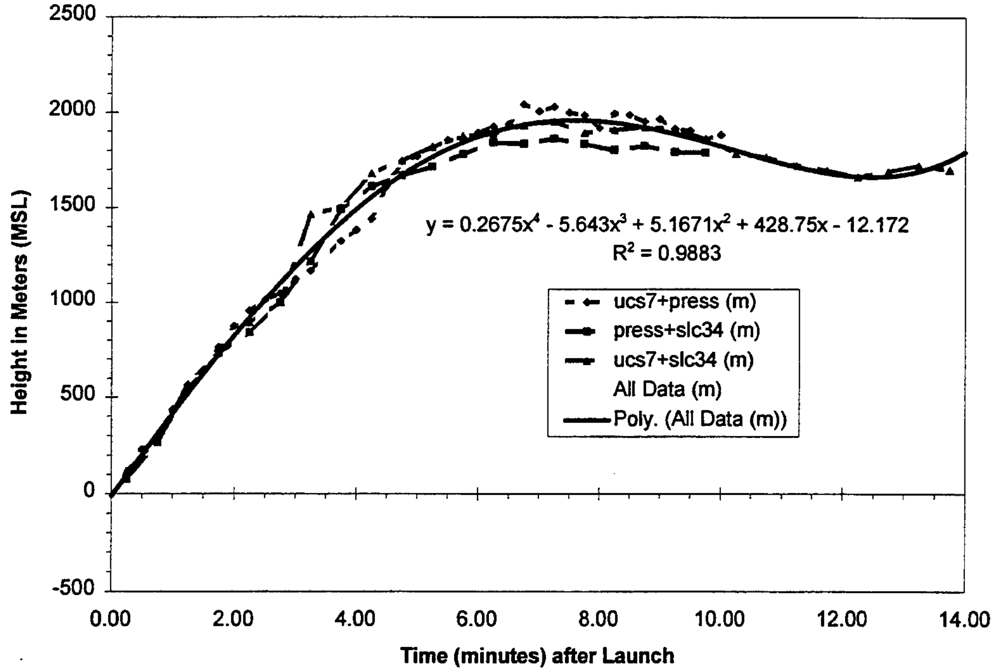


Figure 10. Cloud rise plot for the middle of the #K19 cloud as determined by visible imagery: (a) Three independent determinations are made from the pairwise combination of data from the three imaging sites. These determinations are labeled as ucs7 + press, press + slc34, and ucs7 +slc34. The third-order polynomial fit to the entire set of data is plotted as H(t) vs t (in minutes). The variance (R^2) of 0.9716 indicates the high quality of the fit. (b) All three sets of H(t) vs t data are combined and displayed with the third-order polynomial fit and the 3σ error bands for the stabilization height.



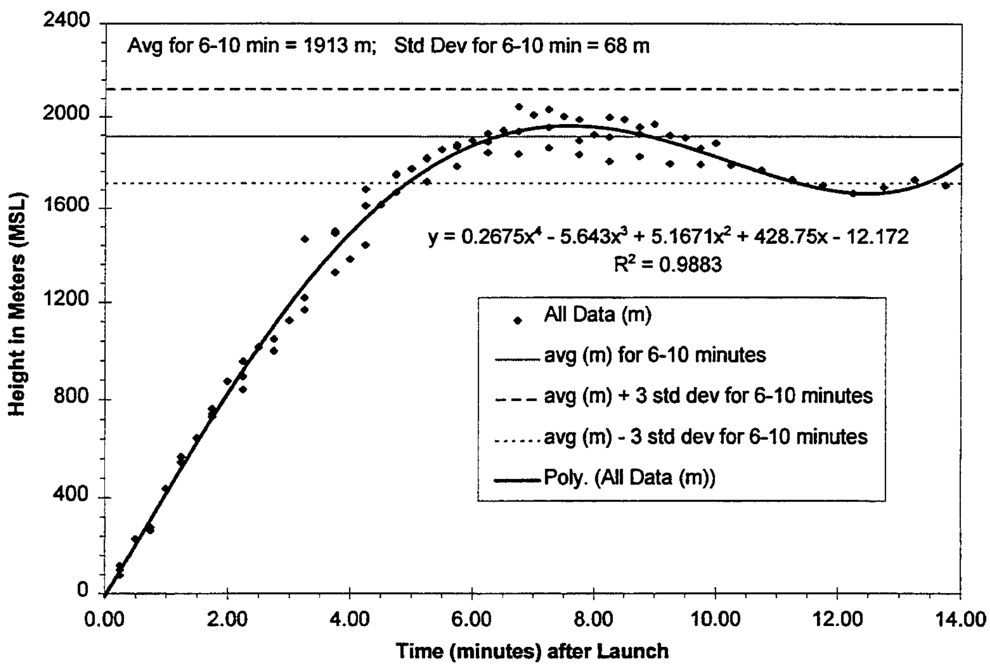
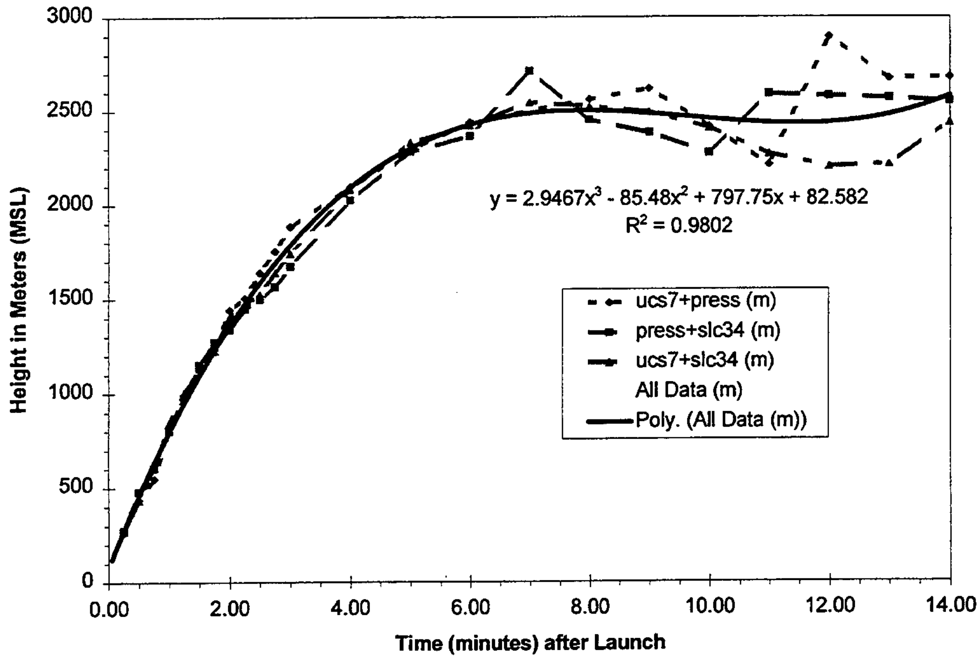


Figure 11. Cloud rise plot for the middle of the #K19 cloud as determined by infrared imagery: (a) Three independent determinations are made from the pairwise combination of data from the three imaging sites. These determinations are labeled as ucs7 + press, press + slc34, and ucs7 + slc34. The fourth-order polynomial fit to the entire set of data is plotted as H(t) vs t (in minutes). The variance (R^2) of 0.9883 indicates the high quality of the fit. (b) All three sets of H(t) vs t data are combined and displayed with the fourth-order polynomial fit and the 3σ error bands for the stabilization height.



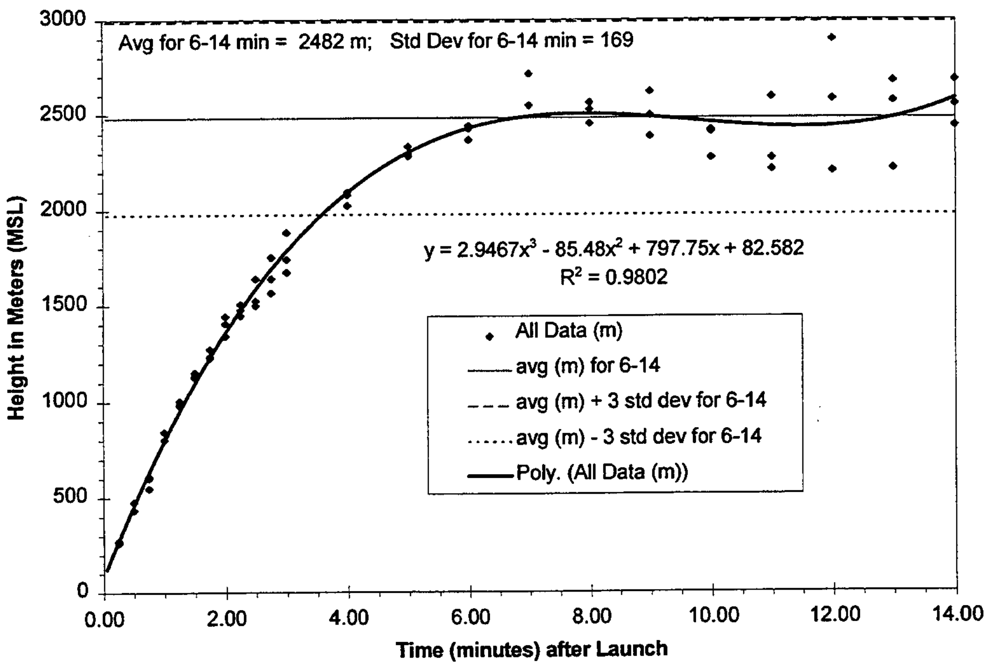
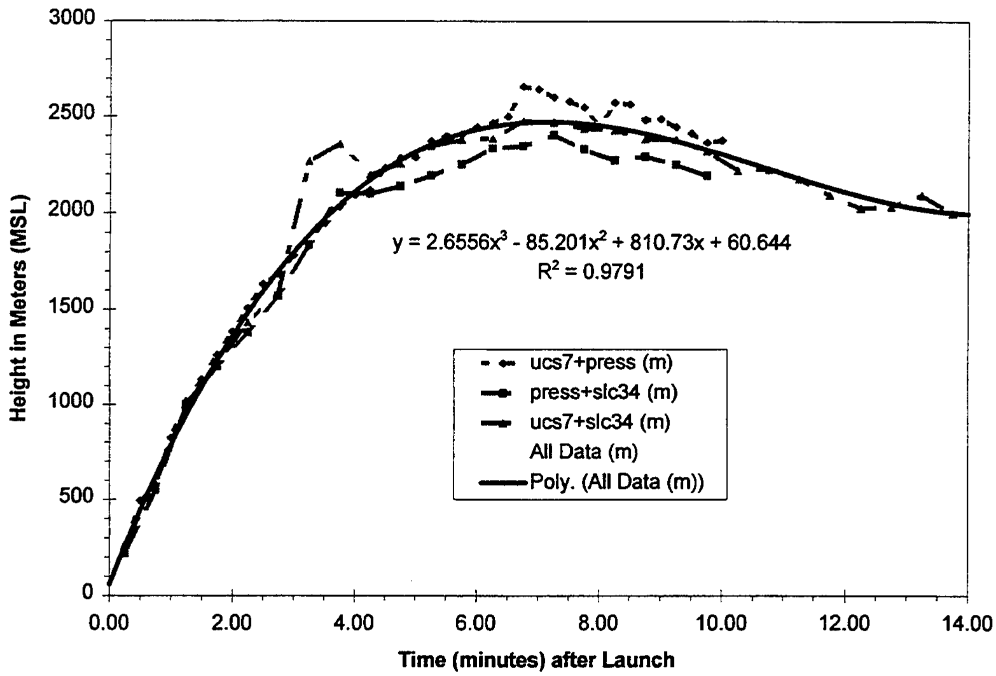


Figure 12. Cloud rise plot for the top of the #K19 cloud as determined by visible imagery: (a) Three independent determinations are made from the pairwise combination of data from the three imaging sites. These determinations are labeled as ucs7 + press, press + slc34, and ucs7 + slc34. The third-order polynomial fit to the entire set of data is plotted as H(t) vs t (in minutes). The variance (R^2) of 0.9802 indicates the high quality of the fit. (b) All three sets of H(t) vs t data are combined and displayed with the third-order polynomial fit and the 3σ error bands for the stabilization height.



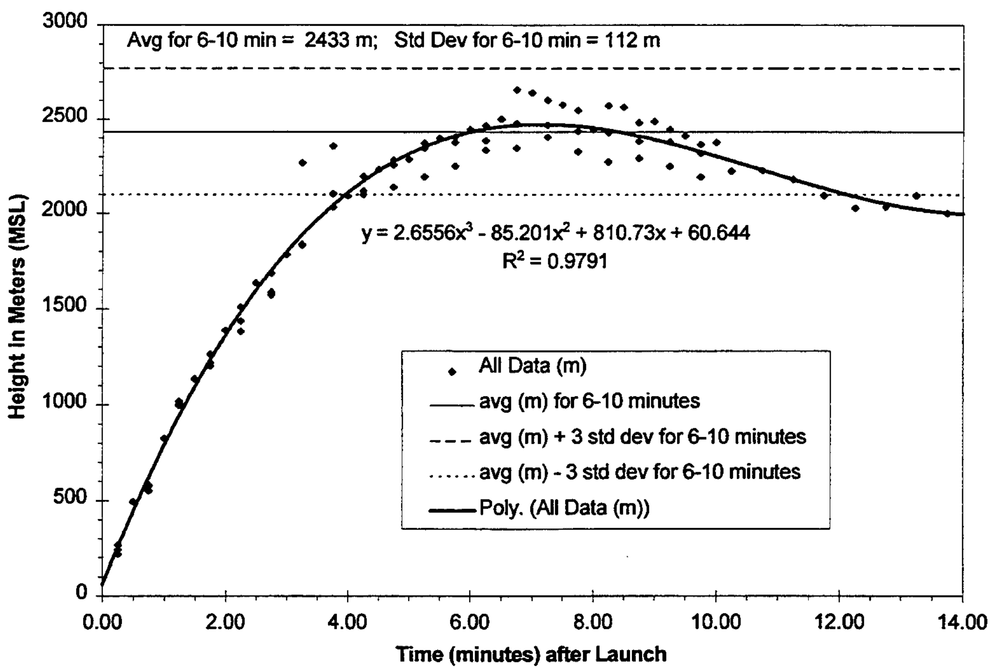


Figure 13. Cloud rise plot for the top of the #K19 cloud as determined by visible imagery: (a) Three independent determinations are made from the pairwise combination of data from the three imaging sites. These determinations are labeled as ucs7 + press, press + slc34, and ucs7 + slc34. The third-order polynomial fit to the entire set of data is plotted as H(t) vs t (in minutes). The variance (R^2) of 0.9791 indicates the high quality of the fit. (b) All three sets of H(t) vs t data are combined and displayed with the third-order polynomial fit and the 3σ error bands for the stabilization height.

2.5.3 Comparison of REEDM Prediction to Imagery Data—Stabilization Height

In Figure 14, the visible ("a") and infrared ("b") determinations of cloud top, cloud middle, and cloud bottom are plotted as a function of time following the launch. It can be seen that the measured stabilization heights of the cloud center (1774 ±137 m [visible] versus 1913 ±68 m [infrared]) are substantially higher than predicted by the T-1 hour REEDM modeling run (851 m) (Appendix C) performed with pre-launch rawinsonde data (Appendix D). The time required to reach the stabilization height (approximately 7–9 min documented by infrared and visible imagery) is also substantially longer than the 6 min predicted by the T-1 hour REEDM modeling run.

The variances (R^2) of the polynomial fits to the data (i.e., Figures 8–13) indicate that the fits are very good. A polynomial fit was used in those figures as a convenient method to permit the representation of cloud overshoot and subsequent damped oscillation around the stabilization height. To be consistent with REEDM, stabilization time and height refer to the first maximum in these fits. REEDM predicts that the cloud goes through damped oscillatory motion with a period of $2\pi/S^{1/2}$, where S is the static stability parameter [Ref. 1, Eq. (7)].[1] Sensitivity of REEDM predictions to input parameters has been examined by Womack.[2] Careful imaging of launch ground clouds under a variety of meteorological conditions is a vital element in REEDM evaluation.

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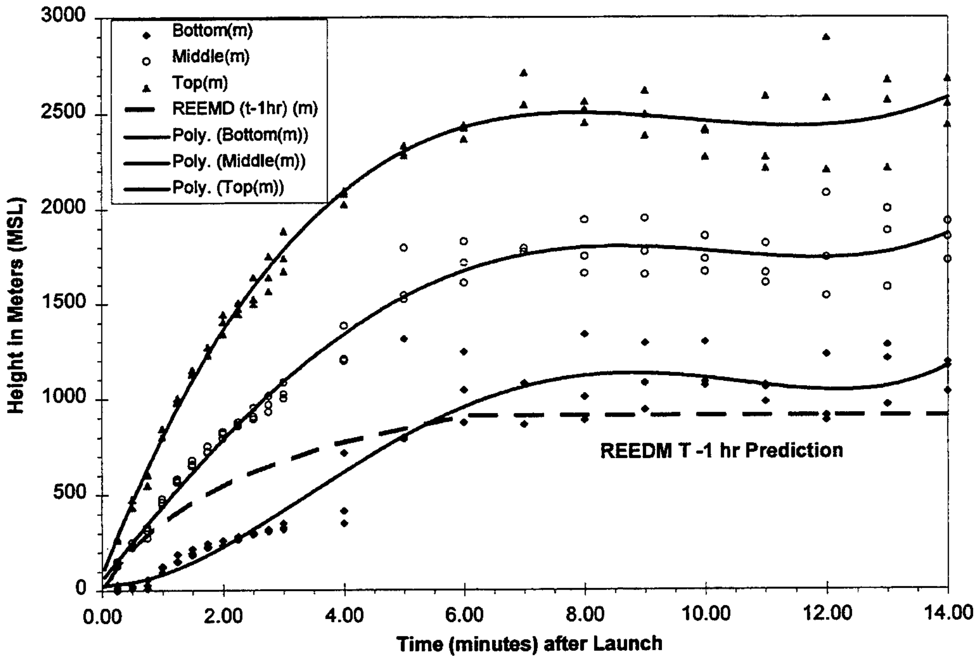
1 J. R. Bjorklund, User's Manual for the REEDM Version 7 (Rocket Exhaust Effluent Diffusion Model) Computer Program, Vol. I, TR-90-157-01, AF Systems Command, Patrick AFB, FL (April 1990).

2 J. M. Womack, Rocket Exhaust Effluent Diffusion Model Sensitivity Study, TOR-95(5448)-3, The Aerospace Corporation, El Segundo, CA (May 1995).



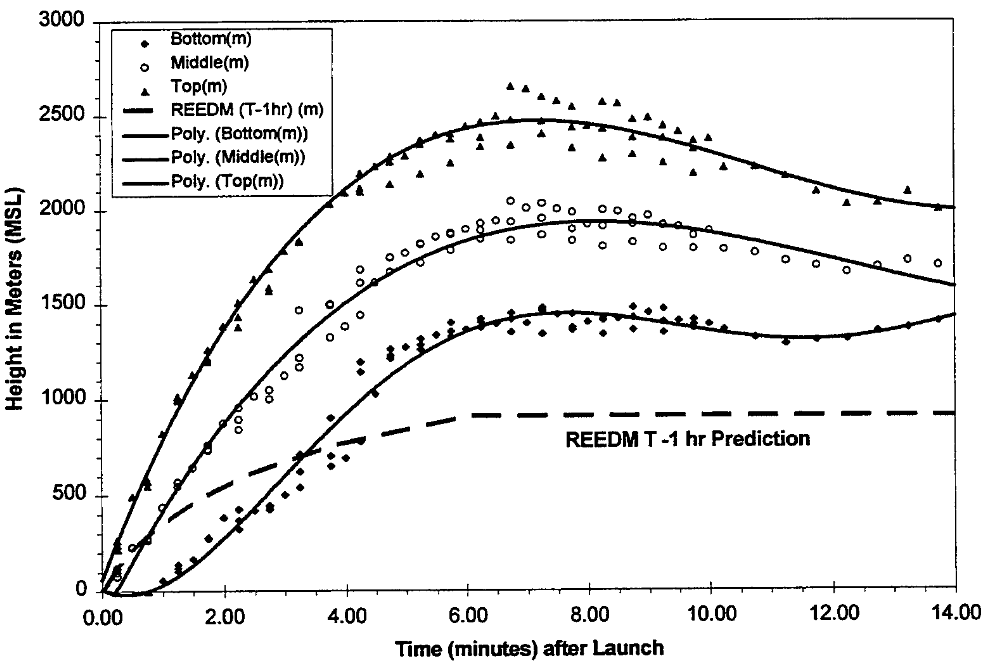


Figure 14. Imagery derived stabilization heights compared to T-1 hour REEDM predictions. The visible imagery data (portion "a") and the infrared imagery data (portion "b") for the three independent determinations for top, middle, and bottom of the ground cloud are plotted as H(t) vs t. The T-1 hour REEDM modeling run predictions for the cloud middle are presented for comparison.

2.5.4 Comparison of REEDM Prediction to Imagery Data—Cloud Trajectory and Speed

Figures 15 and 16 present data for the ground track and for the displacement of the cloud from the launch pad as determined by visible and infrared imagery. The "box" method of analysis for the imagery data does not yield independent values of the cloud track for the top, middle, and bottom of the cloud. We have chosen to present data for the middle of the cloud as defined by PLMTRACK.

To be precise, the cloud data in Figures 15 and 16 represent the ground-plane projection of the trajectory of the middle of the cloud as a function of time. Figure 15 presents visible ("a" portion) and infrared ("b" portion) data from the three imager-site pairs, as well as "average" data computed as a single linear fit to the combined data sets using the following formula:

$$Y = mX + b, \tag{1}$$

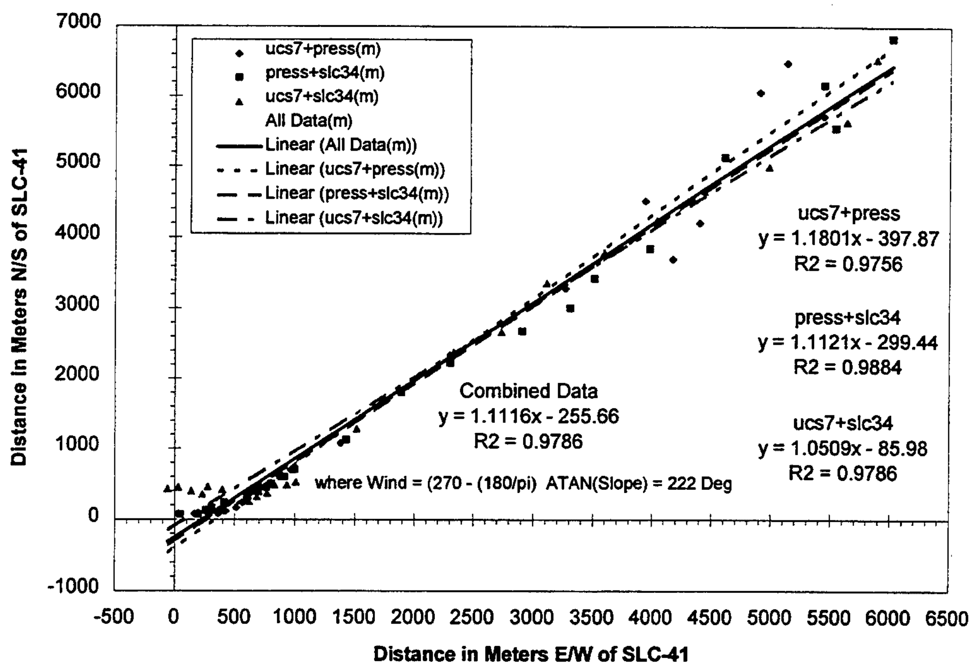
where Y is the distance in meters along the north-south axis, m is the slope of the fit, X is the distance in meters along the east-west axis, and b is the intercept for the fit. We have permitted the intercept (b) to be nonzero since the cloud from the duct, coupled to low-altitude wind shear, can combine to make the apparent origin of the cloud different from the location of the launch complex. That displacement can also be modeled within the REEDM code during cloud rise.

In this report, the angles will conform to the convention of rawinsonde wind vectors (the angle from which the wind originates that would push the cloud into its imaged position). Thus, the angles are related by

$$\vartheta = 180 + \Phi, \tag{2}$$

where ϑ is the equivalent rawinsonde wind angle, and Φ is the measured polar angle of the cloud relative to SLC-41 and clockwise of true north. For example, when the cloud is due east of SLC-41, Φ is 90°, and ϑ is 270°. In Figures 15 "a" and "b," the slope (m) of the fitted lines is determined by the angle θ, where $\theta = \tan^{-1} m$, and therefore $\Phi = 90° - \theta$. Figure 3 showed the mean cloud track vectors documented in Figures 15 a and b along with the wind vectors (T - 1 hour rawinsonde) at the measured stabilization heights superimposed on the map of CCAS/KSC.

Figure 16 presents visible ("a" portion) and infrared ("b" portion) data from the three imager-site pairs without distinction to the imagery sites. For times greater than 4 min, the distance of the cloud from SLC-41 increases linearly with time. A single linear fit to the combined datasets for times longer than 4 min provides the velocity of the stabilized cloud. The visible (a) imagery documents 11.4 m/s cloud velocity with a 0.9859 variance (i.e., R^2) while the infrared (b) imagery documents a 10.6 m/s cloud velocity with a 0.9928 variance (R^2). These cloud velocities are slightly larger than the wind speeds (i.e., 9.3 to 10.3 m/s between altitudes of 1000 and 2500 m) measured by the T-1 hour rawinsonde.



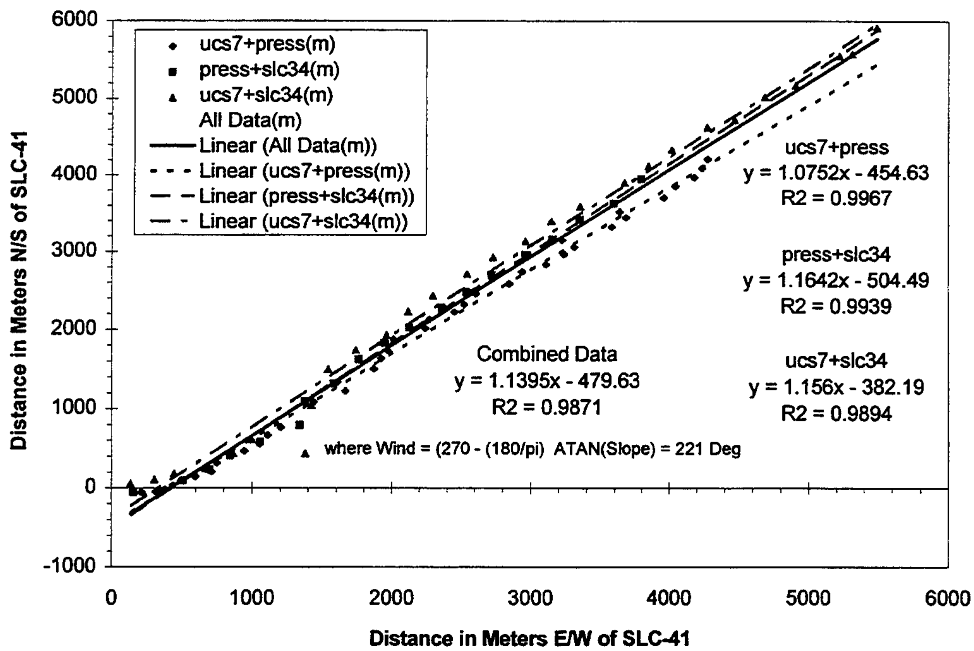
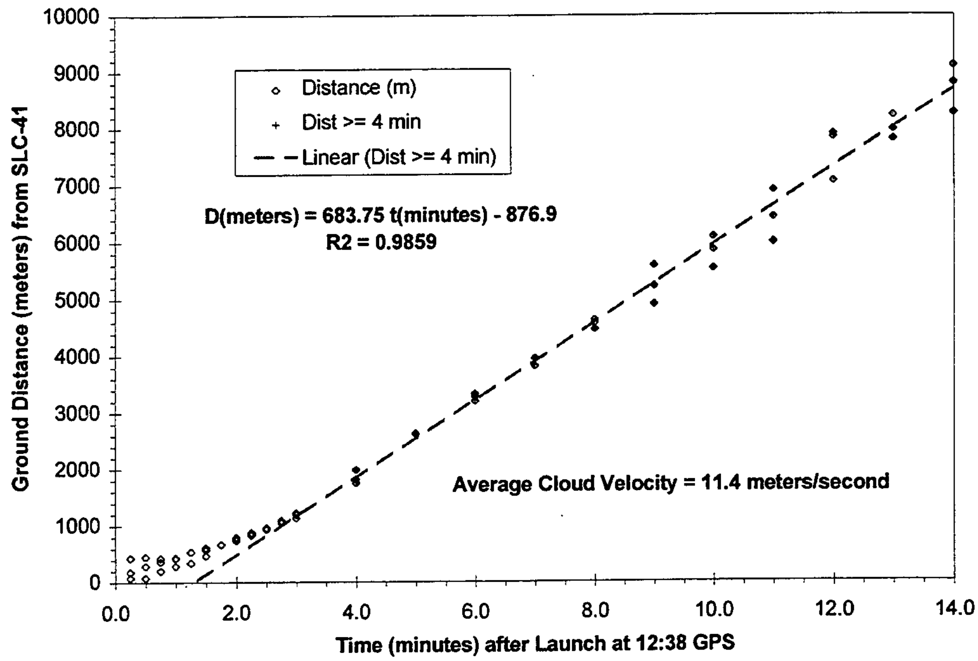


Figure 15. Ground tracks for the middle of the #K19 launch cloud as determined by visible (a) and infrared (b) imagery. Three independent determinations are made from the pairwise combination of data from the three imaging sites for each detection system. These determinations are labeled as ucs7 +press, press + slc34, and ucs7 + slc34. The variances (R^2 = 0.9766 for visible and 0.9871 for infrared) of the linear fits to the combined data are reported, yielding a track of 222° for the visible and 221° for the infrared (rawinsonde convention).



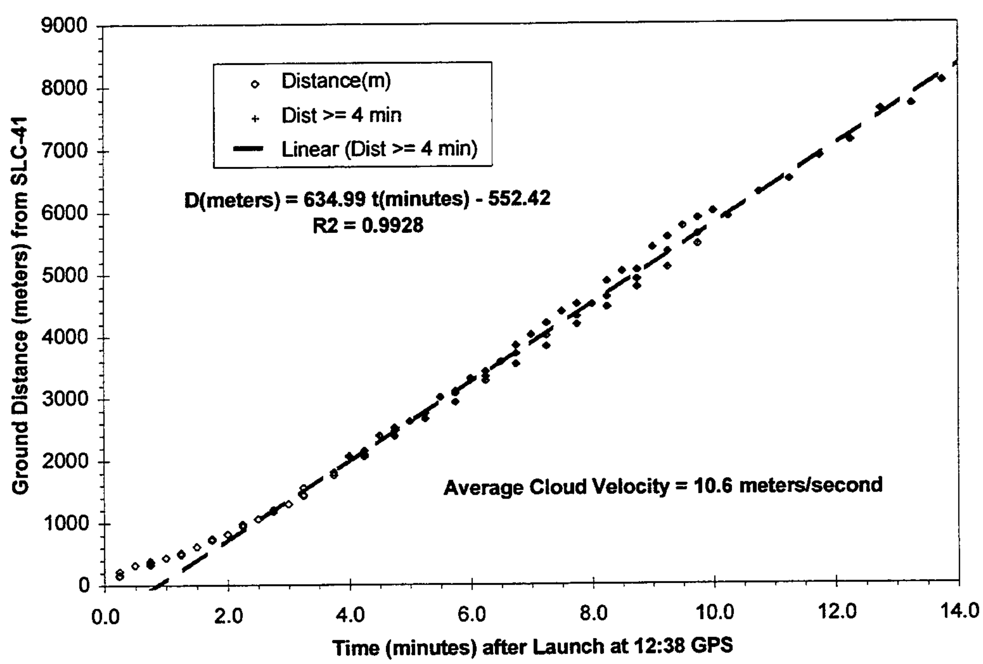


Figure 16. Distance from SLC-41 for the middle of the #K19 launch cloud plotted against time. The data from three independent determinations were made from the pairwise combination of data from the three imaging sites. The three pairs of pairwise data are combined for the visible (a) and the infrared (b) imagery in these distance vs time plots. The variances (R^2 = 0.9859 for visible and 0.9928 for infrared) of the linear fits to the combined data for times longer than 4 min are reported, yielding a cloud velocity of 11.4 m/s from visible imagery and 10.6 m/s from infrared imagery.

2.5.5 Comparison of REEDM Prediction to Imagery Data—Summary Table

Table 1 summarizes the imagery derived, rawinsonde measured, and REEDM-predicted data for the #K19 launch cloud. Several conclusions are derived from review of the contents of this table:

1. the cloud parameters derived by visible and infrared imagery are in agreement with each other;
2. the imagery-derived direction and speed of the cloud are close in value to the T-1 hour rawinsonde data for the imagery-derived stabilization height of the cloud;
3. the REEDM-predicted stabilization height of the cloud is a factor of 2 lower than observed; and
4. the REEDM-predicted cloud direction and speed are significantly different than observed because they are based upon the rawinsonde data for the *predicted* stabilization height (851 m) not the *actual* stabilization height (1774 m).

These data suggest that better prediction of stabilization height by REEDM would automatically correct the wind direction and the wind speed predictions that are based upon the rawinsonde data at the stabilization height.

Table 1. Summary for #K19 Launch Cloud Data Derived from Visible and Infrared Imagery, T-1 Hour Rawinsonde Sounding Data, and T-1 Hour REEDM Predictions

Attribute	Feature	Visible Imagery	Infrared Imagery	Rawinsonde (T-1 hour)	REEDM 7.05 (T-1 hour)
Height (m)	Top	2482	2433	#N/A	#N/A
	Middle	1774	1913	#N/A	851
	Bottom	1080	1394	#N/A	#N/A
Time (min)	Top	7.5	7	#N/A	#N/A
	Middle	9.5	7.5	#N/A	6
	Bottom	8.5	7.5	#N/A	#N/A
Bearing (deg)	Top			216	#N/A
	Middle	222	221	215	242
	Bottom			228	#N/A
Speed (m/s)	Top			9.3	#N/A
	Middle	11.4	10.6	10.3	8.84
	Bottom			9.8	#N/A

2.6 Summary and Conclusions

The Titan IV #K19 mission was launched successfully from the Eastern Range (SLC-41) at 8:38 EDT (12:38Z) on 10 July 1995. Personnel from The Aerospace Corporation deployed three VIRIS platforms (each with a visible and IR imager) to monitor the event and to track the time evolution and the ground trajectory of the solid rocket motor exhaust cloud. The three chosen sites (UCS-7, SLC 34, and the Press Site) were located to the north-northwest, south-southeast, and west relative to launch complex SLC-41. Imagery data were recorded for 60 min, although the cloud was detectable for

roughly a half of that time. When combined with the Az/El readings and the IRIG-B time data, the visible and IR imagery were used to quantify angular movement and growth of the cloud for 14 min after the launch. The launch of #K19 marked the first application of the Titan IV-dedicated VIRIS imaging platforms using both visible and IR imagery to track the ground cloud.

The imagery data documented that the meteorological conditions were favorable for characterization of the launch's exhaust cloud using either visible or IR imagers. The early morning launch time coupled to the cloud trajectory caused difficulties for the visible imagers as they were looking into the sun while it was still at low angles above the horizon. This was not a problem for the IR imagers. The definition of exhaust cloud geometric features was complicated by multiple contributions to the complex shape of the evolving cloud (i.e., asymmetric ejection from the exhaust duct, rapid rise of the hot ground cloud, and separation of the high-altitude launch column). This was particularly true in trying to define the "bottom" and "top" of the cloud. The analyst included only the portions of the exhaust cloud that became incorporated into the stabilized ground cloud.

Analysis of the imagery data presented in this report has focused on determining parameters that are directly comparable to REEDM predictions. The most accurately determined quantities by imagery are the cloud rise time, its stabilization height, its trajectory, and its speed. For Titan IV #K19, T-1 hour REEDM predictions were substantially different from those measured by imagery. The cloud took longer to rise, stabilized at twice the altitude, moved in a more northward direction, and moved at a greater speed than predicted by REEDM using the T-1 hour rawinsonde data. The data suggest that correct prediction of the stabilization height would automatically correct the wind direction and speed predictions that are based upon the rawinsonde data at the predicted stabilization height.

3. Ground-Level HCl Dosimetry

[The material in this section was contributed by Dale Lueck, Dan Curran, Ronald Barile, and Barry Meneghelli of NASA KSC's Toxic Vapor Detection/Contamination Monitoring Laboratory.]

3.1 Dosimeter Monitoring

The primary goal for HCl dosimeter monitoring during this Titan IV launch was collection of ground-level data from near- and far-field locations. Two hundred dosimeters were fabricated and staged with the equipment required for rapid deployment. The calibration data for the prepared dosimeters is shown in Figure 17. Near-field dosimeter deployment was scheduled to be conducted no later than 210 min prior to the opening of the launch window [approximately 0800 EDT (12:00 Zulu time) on 10 July 95]. As a contingency, one of two deployment teams assembled at 0400 EDT and deployed twelve near-field dosimeters within 20,000 ft east of Launch Complex 41. The HCl dosimeters were deployed at varying distances along Samuel Phillips Parkway. Four dosimeters were deployed every 0.25 mi to the north of Complex 41, four dosimeters were deployed every 0.1 mi to the south of Complex 41, three dosimeters were deployed every 0.5 mi starting 0.5 mi south of Complex 41. The last dosimeter was deployed at the 20,000-ft. point south of Complex 41 on Samuel Phillips Parkway adjacent to the security checkpoint. The second of the two teams arrived at 0530 EDT and awaited REEDM predictions at the TVD/CML. The REEDM predictions at 0600 called for the exhaust plume to move east over the ocean, conditions that made far-field ground sampling data unattainable. After evaluation of the dosimeters placed along Samuel Phillips Parkway only two indicated the presence of HCl; their placement is shown in Figure 18.

Several dosimeters were provided to Air Force personnel for near-field placement around the launch complex. A total of 11 dosimeters were placed around Complex 41 the evening prior to launch day. Seven were placed on the perimeter fence 5 ft above ground level approximately 600 ft from the vehicle. Four dosimeters were placed on structures inside the fence, one on each lightning tower approximately 150 ft from the vehicle. The approximate placement and HCl dose measured by these near-field dosimeters is shown in Table 2.

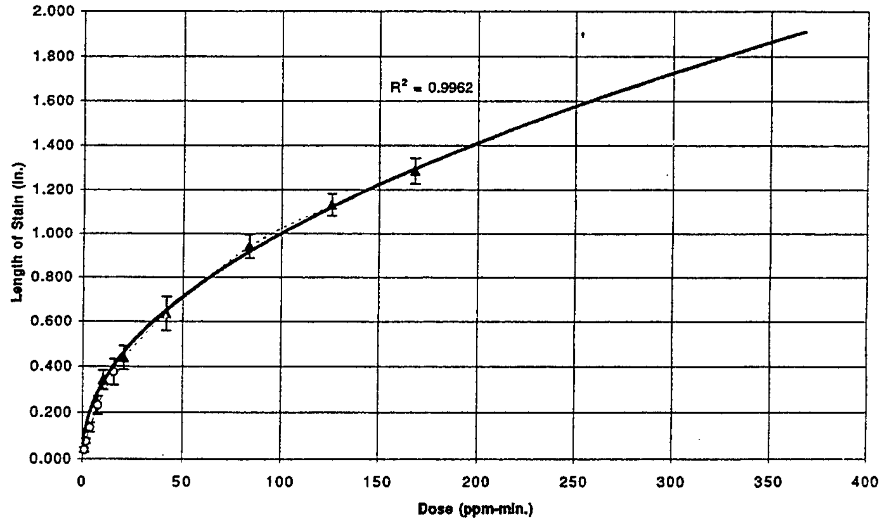


Figure 17. Calibration data for prepared dosimeters. Two sets of calibration results for LOS dosimeters used during 7/10/95 Titan IV monitoring activities. Cal vapor 0.5 and 2.1 ppm HCl. Error bars represent two standard deviations. Trendline extrapolated from high conc. data set.

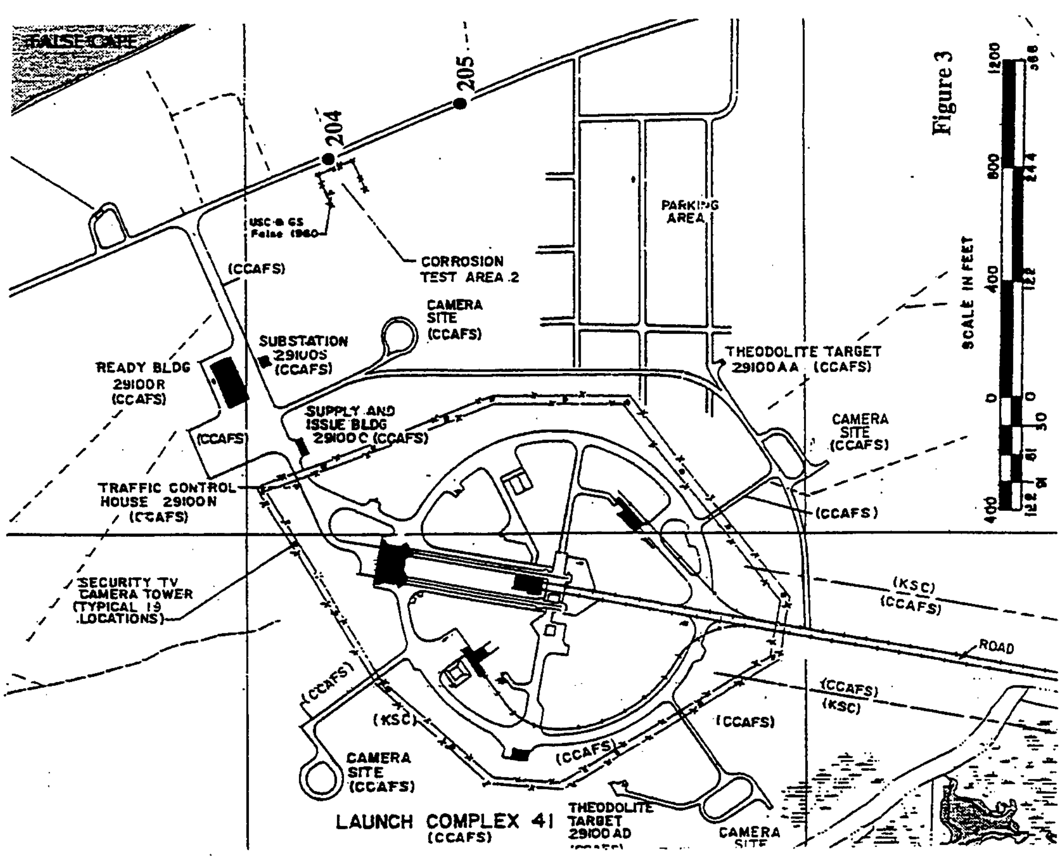


Figure 18. Placement of dosimeters along Phillips Parkway registering HCl response.

Table 2. Near-Field HCl Dosimeter Location, Stain Measurements, and Doses

Map Site #	Dosimeter Location Relative to Vehicle	Stain Length (in.)	Dose (ppm-min)
1	N Perimeter Fence	0.160	2.56
2	WNW Perimeter Fence	0.190	3.61
3	ESE Perimeter Fence	0.056	0.31
4	SSW Perimeter Fence	0.039	0.15
5	S Perimeter Fence	0.110	1.21
6	ESE Perimeter Fence	0.209	4.37
7	ENE Perimeter Fence	0.178	3.17
8	NE Lightning Tower	Saturated	>340.00
9	SE Lightening Tower	Saturated	>340.00
10	SW Lightening Tower	Dosimeter not recovered	Can't Calculate
11	NW Lightning Tower	Saturated	>340.00
#204	East of Tower on Road	0.079	0.62
#205	East of Tower on Road	0.043	0.18
Mobile Team #1	South of Complex 41	0	0
Mobile Team #2	North of Complex 41	<0.001	Can't Calculate

3.2 Ground-Level Monitoring Results

The dosimeters placed in the vicinity of Launch Complex 41 inside the perimeter fence and the dosimeters placed on Samuel Phillips Parkway in line with the flame trench (pad's exhaust duct) showed response indicating the presence of HCl. Data collected from these dosimeters is shown in Figure 19. The highest doses were recorded at the lightning towers on either side of the flame trench, east of the vehicle. From the HCl levels recorded by the dosimeters on the perimeter fence, it appears that the majority of the ground-level HCl moved to the east-northeast. However, low levels of HCl were detected at each of the other perimeter fence locations. Dosimeters placed in the same sites during the 14 May 95 launch also detected HCl at the perimeter fence locations. The dosimeters placed at these sites for the 22 Dec 94 launch with similar wind conditions did not detect HCl. This may indicate that during warmer weather conditions, the effluent plume does not rise as quickly as it does when air and ground temperatures are cooler.

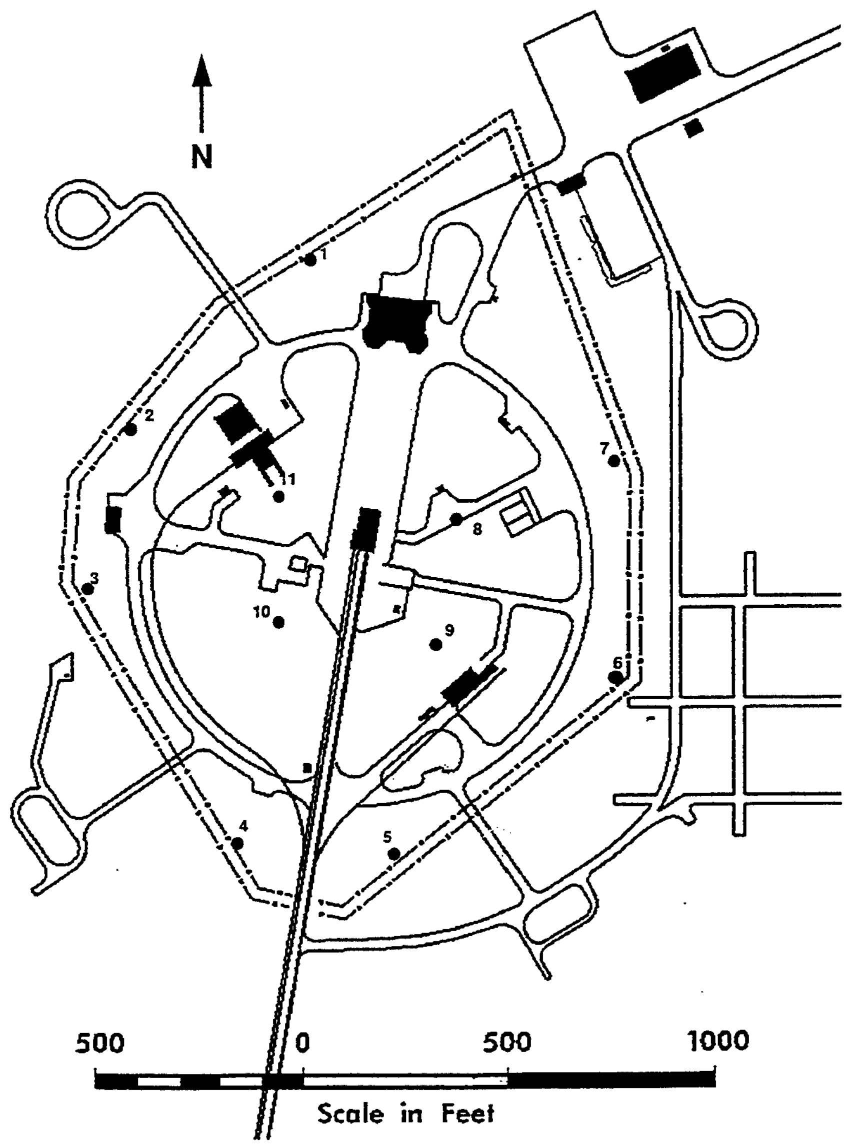


Figure 19. HCl dosimeter placement for complex 41.

3.3 Mobile Monitoring Teams Results

Two dosimeters were provided to the Air Force mobile HCl monitoring teams. Each team attached one of the dosimeters to the side of intake tube on the Geomet HCl monitor. The mobile HCl monitoring teams drove towards Complex 41, along Samuel Phillips Parkway, starting from the security checkpoints approximately 2 min after launch. Mobile Team #1 started from south of Complex 41 and drove towards the complex. Mobile Team #2 started from north of Complex 41 and drove towards the complex. The results obtained from these dosimeters were too low to be calculated.

Appendix A—The REEDM Code

[Material in this Appendix was contributed by Bart Lundblad of The Aerospace Corporation's Environmental Systems Directorate]

The Rocket Exhaust Effluent Diffusion Model (REEDM) is used by range safety offices at the Eastern and Western Ranges to predict toxic hazard corridors (THCs) for a variety of launch vehicles, including Titan and Delta. The code was developed in 1982 for the Air Force by H. E. Cramer Co. Development was based on the earlier NASA multi-layer diffusion model. REEDM is currently operated and periodically modified by a range safety contractor. The latest version can run on a personal computer in several minutes. REEDM calculates atmospheric toxic concentrations based on vehicle emission, meteorological, and launch scenario data provided by the user. Although based on relatively simple atmospheric dispersion physics, the code is complex, with a large number of variables.

REEDM has not been fully validated, and the accuracy of its concentration predictions has been questioned. Key factors determining predicted values include the cloud source terms, cloud rise and stabilization, cloud transport, cloud diffusion, and atmospheric chemistry.

- **Source Term:** REEDM predicts vehicle-specific initial cloud characteristics for both nominal launch and catastrophic failure cases. These characteristics include mass, temperature, buoyancy, and upward momentum. The model does not fully account for exhaust interaction with the launch mount and deluge water. It also does not account for HCl removal via washout, impingement, and rainout.
- **Cloud Rise and Stabilization:** REEDM uses the initial cloud characteristics and the meteorological profile to predict exhaust cloud rise and stabilization. The altitude of the predicted stabilization and the distribution of the cloud about the stabilization height are important determiners of predicted ground-level concentrations. Questions persist as to whether REEDM correctly predicts cloud stabilization heights, and if it properly accounts for cloud interaction with inversion layers that tend to inhibit cloud rise. It is also thought to inaccurately predict air entrainment rates and distribution of cloud mass.
- **Transport:** REEDM uses a single mean wind vector to predict the downwind trajectory of the stabilized cloud. The vector is calculated by averaging wind vectors from the measured wind profile. This simple method will not produce accurate cloud trajectories. In addition, REEDM does not account for changes in wind direction as the cloud moves downwind. Use of a single wind vector results in predictions of straight line cloud trajectory. This method cannot accurately portray true cloud movement.

- **Diffusion:** REEDM uses parameters of atmospheric turbulence to predict the rate at which toxic species in the elevated cloud will diffuse back down to ground level. The diffusion rate used by the model is crucial to the prediction of ground-level concentration isopleths. The simple Gaussian diffusion scheme used by REEDM is probably not valid for elevated cloud diffusion. The stabilized cloud may tend to remain elevated and not readily diffuse to ground level.
- **Cloud Chemistry:** REEDM does not account for atmospheric chemical reactions of the launch cloud's toxic species. REEDM assumes that all HCl emitted remains in the cloud as gaseous HCl. There are important toxic removal processes occurring in the clouds that will reduce toxic ground-level concentrations. A valid model must account for these reactions.

Appendix B—Atmospheric Model Validation Program Activities

[Material in this Appendix was contributed by Bart Lundblad of The Aerospace Corporation's Environmental Systems Directorate]

The Atmospheric Dispersion Model Validation Program (MVP) is carrying out three major activities designed to validate REEDM: (1) the verification of REEDM's code, (2) the evaluation of REEDM's performance using empirical dispersion data, and (3) the establishment of the prediction confidence limits of REEDM based on the code and performance evaluations.

1. **Code Verification**

   The REEDM code is being subjected to a rigorous review of its construction, equations, assumptions, default values, and uncertainties by a team of personnel with expertise in atmospheric modeling. This code verification process is providing a complete explanation of how the model uses input data to produce toxic concentration isopleths, including the inherent limitations that accompany these predictions. The code verification process will improve the understanding of the accuracy of code output and will provide essential information for ultimate model validation.

2. **Model Performance Evaluation**

   The performance of REEDM in producing accurate toxic concentration predictions is being evaluated using empirical data collected during the monitoring of launch clouds and tracer gases. This evaluation process has three components: data collection, data archiving, and model comparison.

   Data Collection: The launch ground clouds produced by nominal launches at the Eastern and Western Ranges are being monitored to collect data on cloud rise, growth, stabilization height, trajectory, diffusion, and toxic ground concentrations. Cloud monitoring potentially includes remote imagery (visible, infrared, and lidar) and both aerial and ground sampling of cloud constituents.

   Releases of tracer gas (non toxic, invisible, and inert) at the Eastern and Western Ranges are being employed to supplement the launch cloud monitoring data. The tracer gas is released at various altitudes during non-launch periods to simulate sections of a stabilized toxic cloud. The puffs and plumes of tracer gas are remotely imaged with infrared cameras and also detected in the air and at ground level. The tracer release activity will provide valuable information on cloud trajectory and diffusion patterns in the coastal environments at the ranges. Tracer release sessions are being conducted during different seasons of the year to account for seasonal variations in dispersion characteristics.

   An important part of the field data collection activity is the production of a complimentary meteorological data package that can be used to evaluate the mete-

orological portions of REEDM. Data provided by the existing range meteorological network will be supplemented, as necessary, by the MVP to ensure that all necessary meteorological data are collected.

Data Archiving: A computerized data storage system will be created to archive cloud dispersion and meteorological data collected during the field activities. The data will be reviewed and reduced prior to archiving. The system will enable a rapid and accurate delivery of requested data to REEDM evaluators. The archive will remain as a valuable resource to be utilized during the evaluations of future range dispersion models.

Model Comparison: Model evaluators will run REEDM using archived meteorological data and compare its output with the empirical cloud dispersion data collected during the field activities. The cloud imagery data will be used to evaluate how closely REEDM can simulate cloud rise growth and stabilization. Imagery and aerial sampling of the launch and tracer clouds will permit evaluation of cloud trajectory and diffusion. The ground sampling data will allow a direct comparison between REEDM toxic concentration isopleths and the actual gas concentration detected at ground level. The aerial and ground sampling will also provide real cloud chemical composition data that will assist evaluation of atmospheric chemical reactions and conversions. The evaluation team will report on the overall accuracy of the REEDM predictions as well as the accuracy of each REEDM component: cloud rise, transport, diffusion, and ground concentration.

3. Establishment of Confidence Limits

The MVP will use the knowledge gained from the REEDM code examination and the REEDM performance evaluation to establish confidence limits for REEDM use and thereby validate REEDM. These confidence limits will be based on REEDM's strengths and weaknesses and will provide guidance on interpretation of model predictions. Establishment of the confidence limits will validate REEDM by providing a firm basis for REEDM use at the ranges.

Appendix C- REEDM Code Calculations of Cloud Stabilization Heights and Ground-Level HCl Exposure Doses

[Material in this Appendix was contributed by Robert Abernathy of The Aerospace Corporation's Environmental Monitoring and Technology Department (EMTD)]

REEDM code calculations of cloud stabilization heights and ground-level HCl exposure doses are presented here from rawinsonde data determined at T-1 hour (11:38 Zulu time).

1. Cloud Stabilization Heights Calculated from T-1 hour Rawinsonde Data

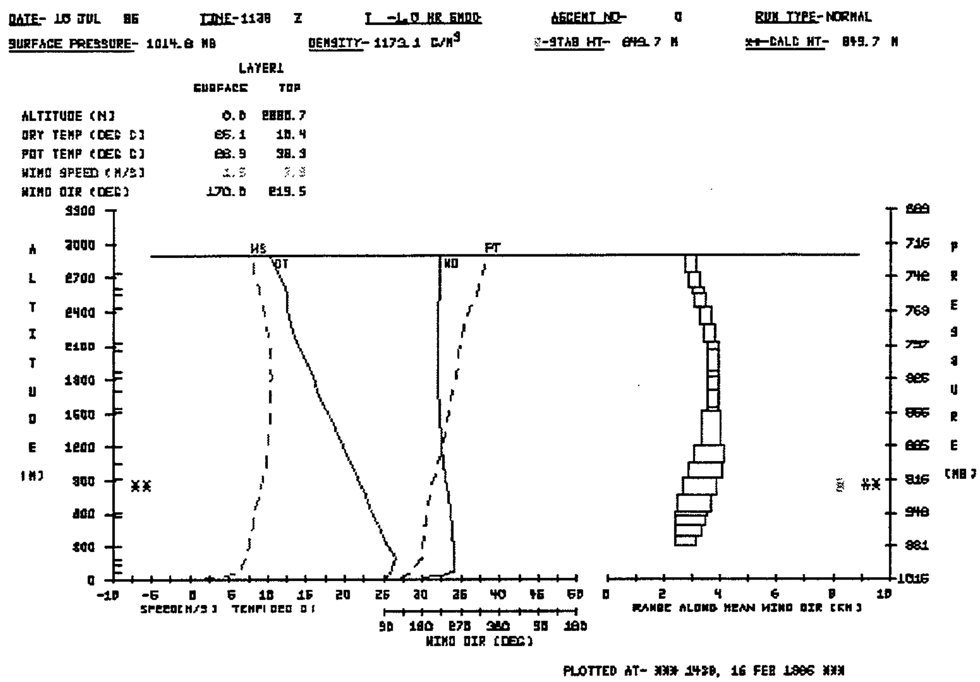


Figure C1. T-1 hour rawinsonde meteorological plot from REEDM version 7.05.

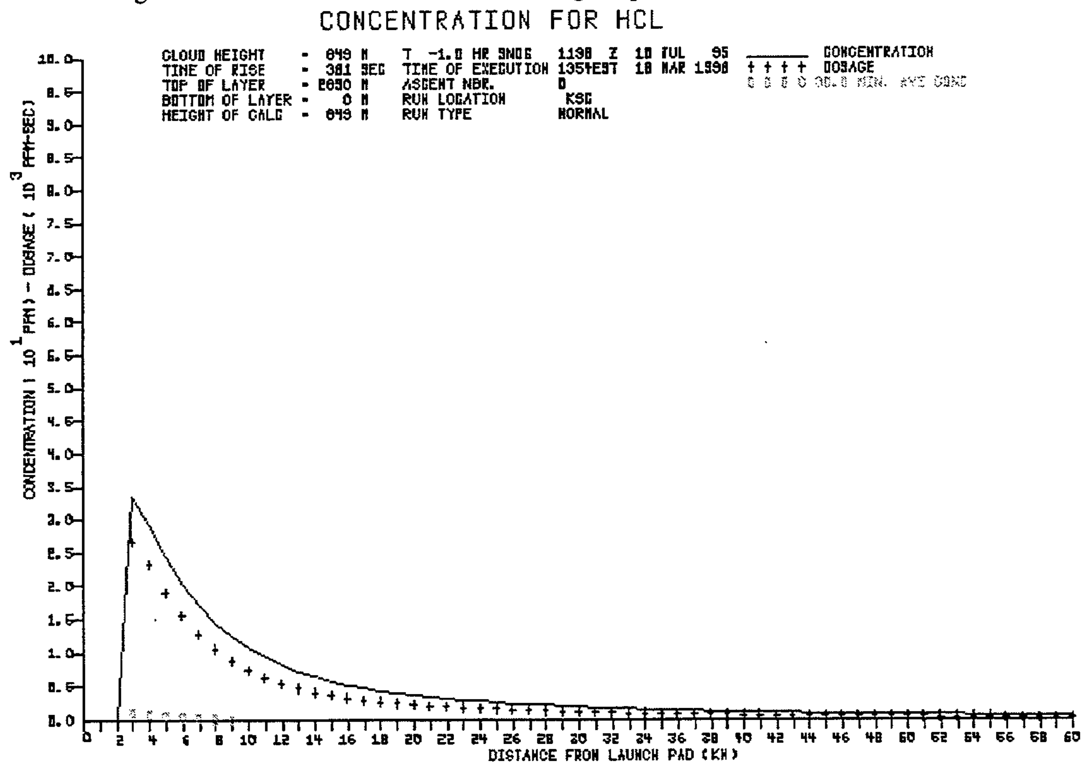


Figure C2. REEDM's stabilized cloud concentration predictions using T-1 hour rawinsonde data.

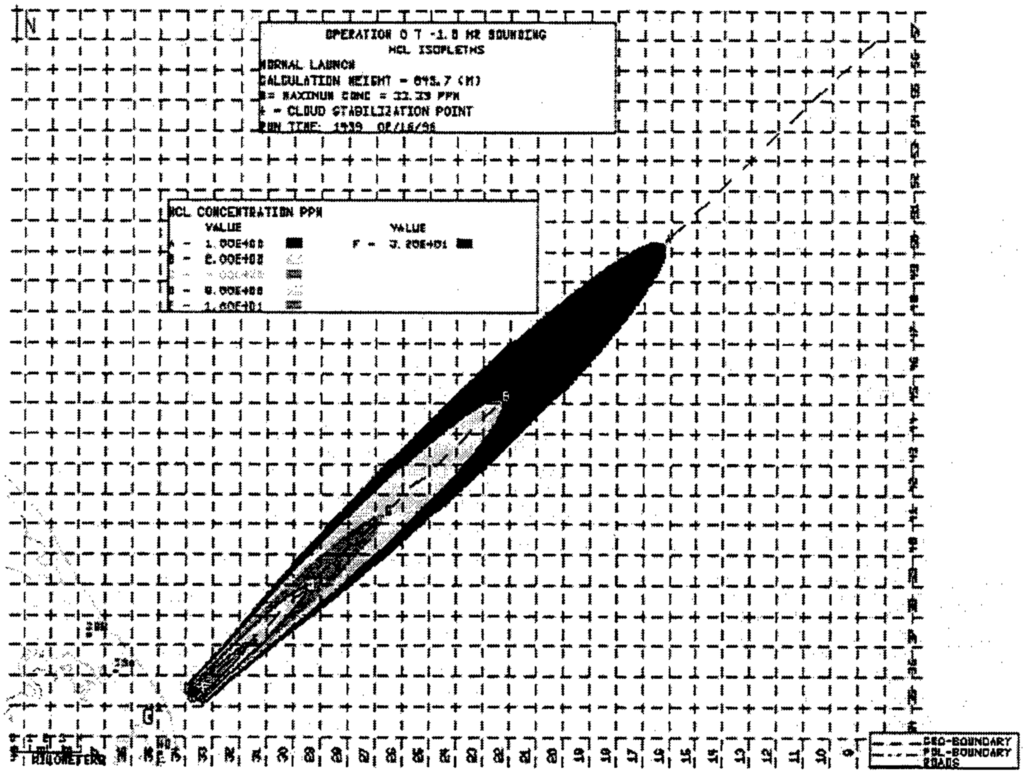


Figure C3. REEDM's stabilized cloud isopleth predictions using T-1 hour rawinsonde data.

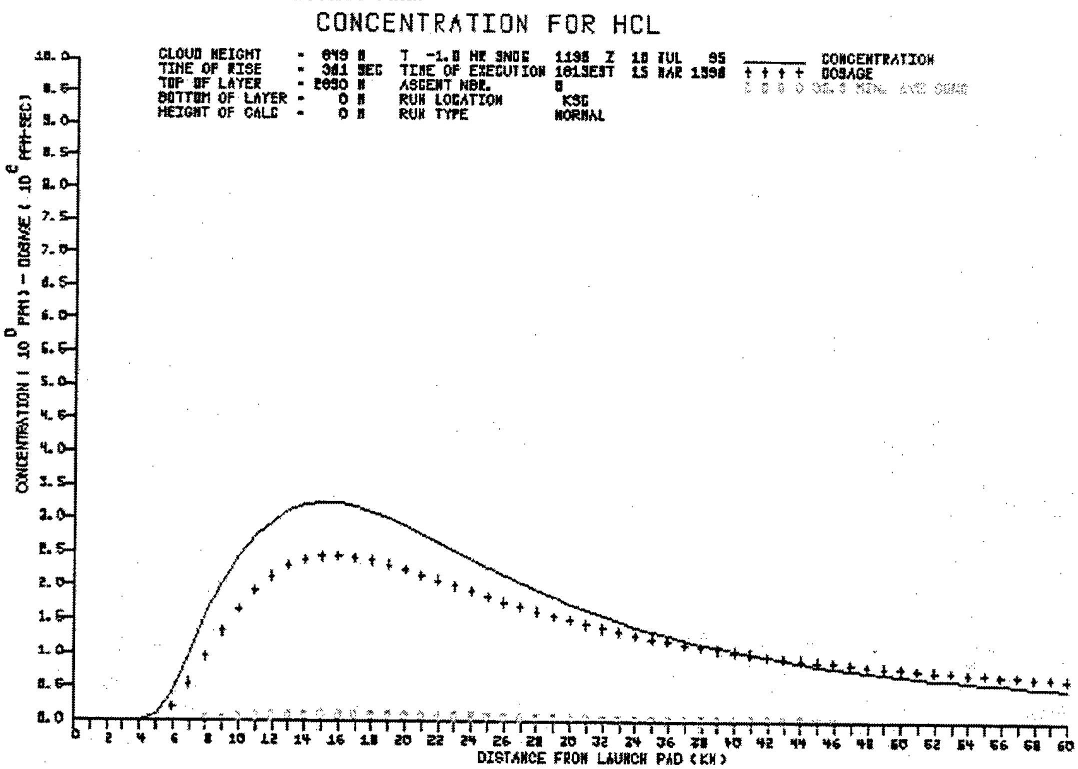


Figure C4. REEDM's surface impact prediction for cloud concentrations using T-1 hour rawinsonde data.

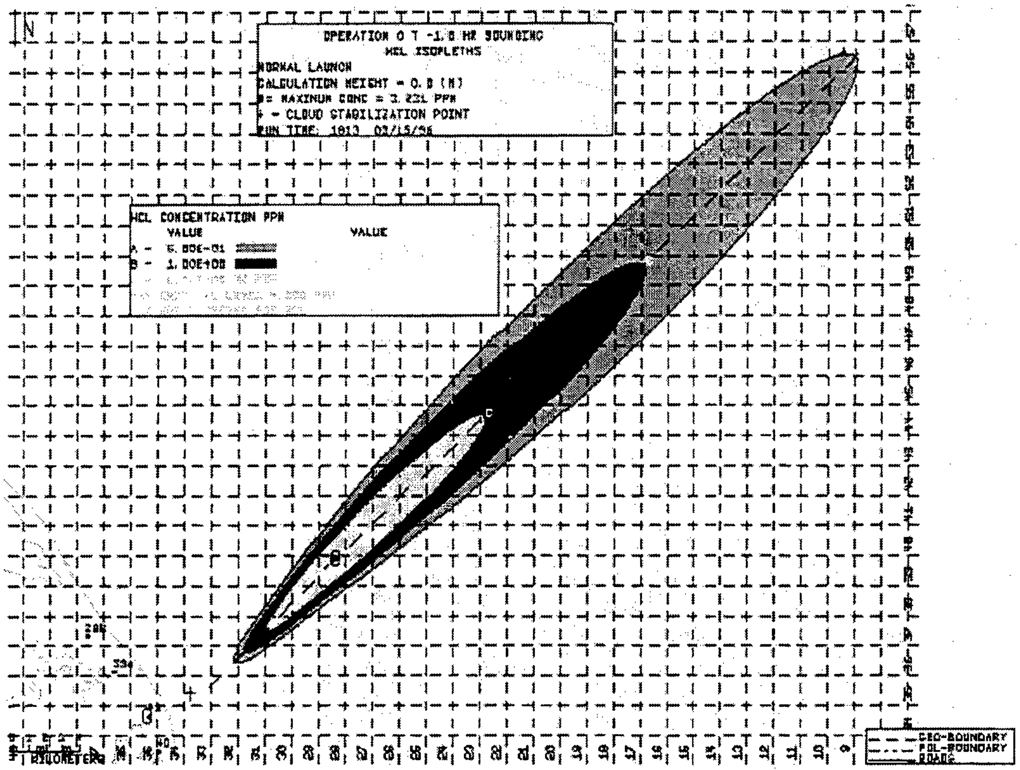


Figure C5. REEDM's surface impact prediction for cloud isopleths using T-1 hour rawinsonde data.

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1****************************************************************************
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                         ----- PROGRAM OPTIONS -----

  MODEL                                                         CONCENTRATION
  RUN TYPE                                                        OPERATIONAL
  WIND-FIELD TERRAIN EFFECTS MODEL                                       NONE
  LAUNCH VEHICLE                                                     TITAN IV
  LAUNCH TYPE                                                          NORMAL
  LAUNCH COMPLEX NUMBER                                                    41
  TURBULENCE PARAMETERS ARE DETERMINED FROM               CLIMATOLOGICAL DATA
  SPECIES                                                                 HCL
  CLOUD SHAPE                                                      ELLIPTICAL
  CALCULATION HEIGHT                                            STABILIZATION
  PROPELLANT TEMPERATURE (DEG. C)                                       28.38
  CONCENTRATION AVERAGING TIME (SEC.)                                 1800.00
  DECAY COEFFICIENT                                                    0.0000
  ABSORPTION COEFFICIENT (RNG- 0 TO 1,NO ABSORPTION=0)                 0.0000
  DIFFUSION COEFFICIENTS                                  LATERAL      1.0000
                                                          VERTICAL     1.0000
  VEHICLE AIR ENTRAINMENT PARAMETER                       GAMMAE       0.6400
  DOWNWIND EXPANSION DISTANCE (METERS)                    LATERAL      100.00
                                                          VERTICAL     100.00

                           ----- DATA FILES -----

                                INPUT FILES
  RAWINSONDE FILE                                                k19_1138.raw
  DATA BASE FILE                                                  rdmbase.ksc

                                OUTPUT FILES
  PRINT FILE                                                     k19d1138.stb
  PLOT FILE                                                      k19d1138.s_p
```

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----- METEOROLOGICAL RAWINSONDE DATA -----

RAWINSONDE MSS/MSS
TIME- 1138 Z DATE- 10 JUL 95
ASCENT NUMBER 0

----- T -1.0 HR SOUNDING -----

MET. LEV. NO.	ALTITUDE MSL (FT)	GND (FT)	GND (M)	WIND DIR (DEG)	WIND SPEED (M/S)	(KTS)	TEMP	AIR PTEMP (DEG C)	DPTEMP	AIR PRESS (MB)	AIR RH (%)	H M	INT-ERP
1	16	0.0	0.0	170	1.5	3.0	25.1	26.9	22.8	1014.8	87.0		
2	57	40.6	12.4	187	2.6	5.0	25.3	27.3	22.9	1013.4	86.6		**
3	97	81.2	24.7	204	3.6	7.0	25.4	27.5	22.9	1012.0	86.1		**
4	138	121.8	37.1	221	4.6	9.0	25.6	27.8	23.0	1010.5	85.6		**
5	178	162.4	49.5	238	5.7	11.0	25.7	28.1	23.0	1009.1	85.1		**
6	219	203.0	61.9	255	6.7	13.0	25.9	28.5	23.1	1007.7	85.0		
7	293	277.3	84.5	255	6.7	13.0	26.0	28.7	22.7	1005.1	81.9		**
8	368	351.7	107.2	255	6.7	13.0	26.1	28.9	22.2	1002.6	79.3		**
9	442	426.0	129.8	255	6.7	13.0	26.2	29.2	21.8	1000.0	77.0		
10	533	517.0	157.6	255	6.9	13.5	26.4	29.5	21.3	996.9	73.6		**
11	624	608.0	185.3	255	7.2	14.0	26.5	29.9	20.7	993.8	71.0		
12	812	796.0	242.6	255	7.4	14.3	26.0	29.9	20.4	987.4	71.1		**
13	1000	984.0	299.9	254	7.5	14.6	25.6	30.0	20.1	981.0	72.0		
14	1309	1292.7	394.0	251	7.8	15.1	24.9	30.2	19.3	970.6	71.2		**
15	1617	1601.3	488.1	249	8.0	15.5	24.3	30.3	18.6	960.2	70.6		**
16	1926	1910.0	582.2	246	8.2	16.0	23.6	30.5	17.8	950.0	70.0		
17	2000	1984.0	604.7	245	8.2	16.0	23.5	30.6	17.5	947.7	69.0		
18	2500	2484.0	757.1	239	8.7	17.0	22.5	31.0	16.3	931.3	68.0		**
19	3000	2984.0	909.5	232	9.3	18.0	21.6	31.4	15.1	915.2	66.0		
20	3472	3456.0	1053.4	228	9.8	19.0	20.8	32.0	14.8	900.0	68.0		
21	4000	3984.0	1214.3	224	10.0	19.5	19.8	32.5	13.9	883.6	69.0		
22	5000	4984.0	1519.1	218	10.3	20.0	17.7	33.4	13.3	852.9	76.0		
23	5088	5072.0	1545.9	218	10.3	20.0	17.4	33.4	13.1	850.0	76.0		
24	5602	5586.0	1702.6	216	10.3	20.0	16.4	33.8	11.9	834.9	75.0		
25	6000	5984.0	1823.9	215	10.4	20.2	15.8	34.3	10.8	823.1	73.0		
26	6153	6137.0	1870.6	214	10.3	20.0	15.5	34.4	10.4	818.6	72.0		
27	6782	6766.0	2062.3	214	10.3	20.0	14.1	34.7	7.4	800.0	64.0		
28	7000	6984.0	2128.7	214	10.1	19.7	13.7	34.8	6.4	794.1	61.0		
29	7500	7484.0	2281.1	215	9.7	18.9	13.0	35.4	2.6	779.9	49.7		**
30	8000	7984.0	2433.5	216	9.3	18.1	12.4	36.1	-1.3	765.9	40.0		
31	8400	8384.0	2555.4	217	8.7	17.0	12.4	37.0	-6.9	754.9	25.0		
32	8561	8545.0	2604.5	217	8.7	17.0	12.1	37.3	-8.0	750.0	24.0		
33	9000	8984.0	2738.3	218	8.2	15.9	11.3	37.7	-10.5	738.6	21.0		
34	9500	9484.0	2890.7	220	7.9	15.4	10.4	38.3	-11.3	725.2	21.5	*	**

* - INDICATES THE CALCULATED TOP OF THE SURFACE MIXING LAYER

** - INDICATES THAT DATA IS LINEARLY INTERPOLATED FROM INPUT METEOROLOGY

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----- METEOROLOGICAL RAWINSONDE DATA -----

SURFACE AIR DENSITY (GM/M**3)	1173.08
DEFAULT CALCULATED MIXING LAYER HEIGHT (M)	2890.72
CLOUD COVER IN TENTHS OF CELESTIAL DOME	0.0
CLOUD CEILING (M)	9999.0

----- PLUME RISE DATA -----

EXHAUST RATE OF MATERIAL-	(GRAMS/SEC)		4.24344E+06
TOTAL MATERIAL OUTPUT-	(GRAMS)		5.36146E+08
HEAT OUTPUT PER GRAM-	(CALORIES)		1555.5800
VEHICLE RISE TIME PARAMETERS-	(TK=(A*Z**B)+C)	A=	0.8678
		B=	0.4500
		C=	0.0000

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----- EXHAUST CLOUD -----

MET. LAYER NO.	TOP OF LAYER (METERS)	CLOUD RISE TIME (SECONDS)	CLOUD RISE RANGE (METERS)	CLOUD RISE BEARING (DEGREES)	STABILIZED CLOUD RANGE (METERS)	STABILIZED CLOUD BEARING (DEGREES)
1	12.4	2.4	2.1	356.1	0.0	0.0
2	24.7	3.7	6.7	3.9	0.0	0.0
3	37.1	5.0	11.2	12.5	0.0	0.0
4	49.5	6.2	16.4	22.4	0.0	0.0
5	61.9	7.5	22.4	33.2	0.0	0.0
6	84.5	10.0	32.9	47.4	0.0	0.0
7	107.2	12.7	49.0	56.9	0.0	0.0
8	129.8	15.7	67.4	61.9	0.0	0.0
9	157.6	19.7	90.5	65.3	0.0	0.0
10	185.3	24.2	119.6	67.7	0.0	0.0
11	242.6	34.7	173.2	69.9	0.0	0.0
12	299.9	46.8	256.4	71.4	0.0	0.0
13	394.0	70.2	390.4	72.2	2615.3	72.6
14	488.1	98.6	590.9	71.8	2662.8	70.4
15	582.2	132.9	841.1	70.9	2696.6	68.4
16	604.7	142.4	1019.9	70.1	2824.2	67.2
17	757.1	225.0	1401.9	68.3	2559.0	65.3
18	909.5	361.8 *	2961.3	62.5	2961.3	62.5
19	1053.4	361.8 *	2961.3	62.5	2961.3	62.5
20	1214.3	361.8 *	2961.3	62.5	2961.3	62.5
21	1519.1	361.8 *	2961.3	62.5	2961.3	62.5
22	1545.9	361.8 *	2961.3	62.5	2961.3	62.5
23	1702.6	361.8 *	2961.3	62.5	2961.3	62.5
24	1823.9	361.8 *	2961.3	62.5	2961.3	62.5
25	1870.6	361.8 *	2961.3	62.5	2961.3	62.5
26	2062.3	361.8 *	2961.3	62.5	2961.3	62.5
27	2128.7	361.8 *	2961.3	62.5	2961.3	62.5
28	2281.1	361.8 *	2961.3	62.5	2961.3	62.5
29	2433.5	361.8 *	2961.3	62.5	2961.3	62.5
30	2555.4	361.8 *	2961.3	62.5	2961.3	62.5
31	2604.5	361.8 *	2961.3	62.5	2961.3	62.5
32	2738.3	361.8 *	2961.3	62.5	2961.3	62.5
33	2890.7	361.8 *	2961.3	62.5	2961.3	62.5

* - INDICATES CLOUD STABILIZATION TIME WAS USED

1***

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----- EXHAUST CLOUD -----

MET. LAYER NO.	TOP OF LAYER (METERS)		LAYER SOURCE STRENGTH (GRAMS)	CLOUD UPDRAFT VELOCITY (M/S)	CLOUD RADIUS (METERS)	STD. DEVIATION MATERIAL DIST. ALONGWIND (METERS)	CROSSWIND (METERS)
1	12.4		0.00000E+00	8.3	0.0	0.0	0.0
2	24.7		0.00000E+00	9.8	0.0	0.0	0.0
3	37.1		0.00000E+00	10.0	0.0	0.0	0.0
4	49.5		0.00000E+00	9.8	0.0	0.0	0.0
5	61.9		0.00000E+00	9.5	0.0	0.0	0.0
6	84.5		0.00000E+00	8.7	0.0	0.0	0.0
7	107.2		0.00000E+00	8.0	0.0	0.0	0.0
8	129.8		0.00000E+00	7.3	0.0	0.0	0.0
9	157.6		0.00000E+00	6.5	0.0	0.0	0.0
10	185.3		0.00000E+00	5.9	0.0	0.0	0.0
11	242.6		0.00000E+00	5.0	0.0	0.0	0.0
12	299.9		0.00000E+00	4.4	0.0	0.0	0.0
13	394.0		1.40158E+06	3.6	354.5	165.2	165.2
14	488.1		4.29334E+06	3.0	459.8	214.3	214.3
15	582.2		6.58804E+06	2.5	528.7	246.3	246.3
16	604.7		1.85419E+06	2.3	559.2	260.6	260.6
17	757.1		1.44560E+07	1.4	591.6	275.7	275.7
18	909.5	*	1.83791E+07	0.0	614.9	286.6	286.6
19	1053.4	*	1.96249E+07	0.0	600.9	280.0	280.0
20	1214.3	*	1.78103E+07	0.0	545.6	254.2	254.2
21	1519.1	*	1.40065E+07	0.0	333.3	155.3	155.3
22	1545.9	*	7.86512E+05	0.0	199.9	93.2	93.2
23	1702.6	*	4.45076E+06	0.0	199.9	93.2	93.2
24	1823.9	*	3.29360E+06	0.0	199.9	93.2	93.2
25	1870.6	*	1.23396E+06	0.0	199.9	93.2	93.2
26	2062.3	*	4.90302E+06	0.0	199.9	93.2	93.2
27	2128.7	*	1.64040E+06	0.0	199.9	93.2	93.2
28	2281.1	*	3.65900E+06	0.0	199.9	93.2	93.2
29	2433.5	*	3.52687E+06	0.0	199.9	93.2	93.2
30	2555.4	*	2.73490E+06	0.0	199.9	93.2	93.2
31	2604.5	*	1.08051E+06	0.0	199.9	93.2	93.2
32	2738.3	*	2.89053E+06	0.0	199.9	93.2	93.2
33	2890.7	*	3.19907E+06	0.0	199.9	93.2	93.2

* - INDICATES CLOUD STABILIZATION TIME WAS USED

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----- CLOUD STABILIZATION -----

CALCULATION HEIGHT	(METERS)	849.68
STABILIZATION HEIGHT	(METERS)	849.68
STABILIZATION TIME	(SECS)	361.82
FIRST MIXING LAYER HEIGHT-	(METERS)	TOP = 2890.72
		BASE= 0.00
SIGMAR(AZ) AT THE SURFACE	(DEGREES)	13.9121
SIGMER(EL) AT THE SURFACE	(DEGREES)	3.2984

MET. LAYER NO.	WIND SPEED (M/SEC)	WIND SPEED SHEAR (M/SEC)	WIND DIRECTION (DEG)	WIND DIRECTION SHEAR (DEG)	SIGMA OF AZI ANG (DEG)	SIGMA OF ELE ANG (DEG)
1	2.21	1.03	178.50	17.00	12.0609	4.0849
2	3.09	1.03	195.50	17.00	9.7925	5.1476
3	4.12	1.03	212.50	17.00	9.1472	5.5998
4	5.14	1.03	229.50	17.00	8.7642	5.9074
5	6.17	1.03	246.50	17.00	8.4926	6.1453
6	6.69	0.00	255.00	0.00	8.2183	6.4065
7	6.69	0.00	255.00	0.00	6.3512	5.2602
8	6.69	0.00	255.00	0.00	4.5988	3.9225
9	6.82	0.26	255.00	0.00	4.4730	3.8151
10	7.07	0.26	255.00	0.00	4.3276	3.6911
11	7.28	0.15	254.75	-0.50	4.2208	3.6000
12	7.43	0.15	254.25	-0.50	4.1228	3.5164
13	7.63	0.24	252.67	-2.67	4.0070	3.4177
14	7.87	0.24	250.00	-2.67	3.8865	3.3149
15	8.11	0.24	247.33	-2.67	3.7998	3.2409
16	8.23	0.00	245.50	-1.00	3.7160	3.1695
17	8.49	0.51	241.75	-6.50	3.5558	3.0328
18	9.00	0.51	235.25	-6.50	3.3576	2.8638
19	9.52	0.51	230.00	-4.00	3.1997	2.7291
20	9.90	0.26	226.00	-4.00	3.0956	2.6403
21	10.16	0.26	221.00	-6.00	3.0365	2.5899
22	10.29	0.00	218.00	0.00	3.0172	2.5734
23	10.29	0.00	217.00	-2.00	3.0097	2.5671
24	10.34	0.10	215.50	-1.00	3.0022	2.5607
25	10.34	-0.10	214.50	-1.00	3.0097	2.5671
26	10.29	0.00	214.00	0.00	3.0287	2.5832
27	10.21	-0.15	214.00	0.00	3.0840	2.6305
28	9.93	-0.41	214.50	1.00	3.0768	2.6338
29	9.52	-0.41	215.50	1.00	2.7588	2.3986
30	9.03	-0.57	216.50	1.00	2.3205	2.0683

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ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM PAGE 8
VERSION 7.05 AT KSC
1354 EST 18 MAR 1996
launch time: 0838 EDT 10 JUL 1995
RAWINSONDE ASCENT NUMBER 0, 1138 Z 10 JUL 95 T -1.0 HR

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----- CALCULATED METEOROLOGICAL LAYER PARAMETERS -----

MET. LAYER NO.	WIND SPEED (M/SEC)	WIND SPEED SHEAR (M/SEC)	WIND DIRECTION (DEG)	WIND DIRECTION SHEAR (DEG)	SIGMA OF AZI ANG (DEG)	SIGMA OF ELE ANG (DEG)
31	8.75	0.00	217.00	0.00	1.9660	1.8009
32	8.46	-0.57	217.50	1.00	1.5065	1.4465
33	8.05	-0.26	218.75	1.50	1.2303	1.2303

TRANSITION LAYER NUMBER- 1

VALUE AT	HEIGHT (METERS)	TEMP. (DEG K)	WIND SPEED (M/SEC)	WIND SPEED SHEAR (M/SEC)	WIND DIR. (DEG)	WIND DIR. SHEAR (DEG)	SIGMA AZI. (DEG)	SIGMA ELE. (DEG)
TOP-	2890.72	311.43	7.92		219.50		1.2303	1.2303
LAYER-			8.82	1.06	225.66	9.11	3.2403	2.7246
BOTTOM-	0.00	300.10	1.54		170.00		13.9121	3.2984

1***
ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM PAGE 9
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1354 EST 18 MAR 1996
launch time: 0838 EDT 10 JUL 1995
RAWINSONDE ASCENT NUMBER 0, 1138 Z 10 JUL 95 T -1.0 HR
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----- MAXIMUM CENTERLINE CALCULATIONS -----

CONCENTRATION OF HCL AT A HEIGHT OF 849.7 METERS
DOWNWIND FROM A TITAN IV NORMAL LAUNCH
CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 2890.7 METERS

RANGE FROM PAD (METERS)	BEARING FROM PAD (DEGREES)	PEAK CONCEN-TRATION (PPM)	CLOUD ARRIVAL TIME (MIN)	CLOUD DEPARTURE TIME (MIN)
3000.187	62.319	33.390	3.517	7.262
4000.116	58.227	29.323	3.826	9.164
5000.000	55.565	24.294	5.889	11.044
6000.015	54.097	20.240	7.933	12.919
7000.007	52.781	17.084	9.975	14.792
8000.003	51.952	14.521	12.006	16.657
9000.002	51.192	12.419	14.037	19.174
10000.001	50.647	10.705	16.063	21.270
11000.001	50.258	9.299	18.085	23.363
12000.001	49.985	8.136	20.103	25.456
13000.000	49.532	7.173	21.944	27.557
14000.000	49.417	6.369	23.537	29.650
15000.000	49.083	5.700	25.135	31.751
16000.000	48.791	5.134	26.732	33.852
17000.000	48.813	4.652	28.320	35.945
18000.000	48.586	4.245	29.915	38.047
19000.000	48.383	3.893	31.508	40.149
20000.000	48.200	3.587	33.101	42.251
21000.000	48.034	3.318	34.693	44.353
22000.000	48.170	3.077	36.277	46.446
23000.000	48.034	2.866	37.868	48.549
24000.000	47.909	2.677	39.458	50.652
25000.000	47.794	2.506	41.048	52.755
26000.000	47.688	2.350	42.638	54.858
27000.000	47.589	2.209	44.227	56.961
28000.000	47.498	2.079	45.816	59.064
29000.000	47.413	1.960	47.404	61.167
30000.000	47.334	1.850	48.993	63.271
31000.000	47.260	1.748	50.581	65.375
32000.000	47.484	1.652	52.161	67.468
33000.000	47.419	1.566	53.749	69.572
34000.000	47.358	1.486	55.336	71.701
35000.000	47.301	1.412	56.924	73.917
36000.000	47.246	1.343	58.511	76.134
37000.000	47.195	1.279	60.098	78.350
38000.000	47.146	1.219	61.685	80.567
39000.000	47.100	1.163	63.272	82.783

1***
ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM PAGE 10
VERSION 7.05 AT KSC
1354 EST 18 MAR 1996
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RAWINSONDE ASCENT NUMBER 0, 1138 Z 10 JUL 95 T -1.0 HR
****

----- MAXIMUM CENTERLINE CALCULATIONS -----

CONCENTRATION OF HCL AT A HEIGHT OF 849.7 METERS
DOWNWIND FROM A TITAN IV NORMAL LAUNCH
CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 2890.7 METERS

RANGE FROM PAD (METERS)	BEARING FROM PAD (DEGREES)	PEAK CONCEN-TRATION (PPM)	CLOUD ARRIVAL TIME (MIN)	CLOUD DEPARTURE TIME (MIN)
40000.000	47.056	1.110	64.859	85.000
41000.000	47.015	1.061	66.446	87.217
42000.000	46.975	1.015	68.032	89.435
43000.000	46.937	0.972	69.619	91.652
44000.000	46.901	0.932	71.205	93.870
45000.000	46.866	0.894	72.791	96.087
46000.000	46.833	0.858	74.378	98.305
47000.000	46.801	0.824	75.964	100.523
48000.000	46.771	0.793	77.550	102.741
49000.000	46.742	0.763	79.136	104.959
50000.000	46.714	0.735	80.722	107.177
51000.000	46.687	0.708	82.308	109.395
52000.000	46.662	0.683	83.894	111.614
53000.000	46.637	0.659	85.480	113.832
54000.000	46.613	0.636	87.066	116.051
55000.000	46.590	0.614	88.651	118.269
56000.000	46.568	0.594	90.237	120.488
57000.000	46.546	0.575	91.823	122.707
58000.000	46.525	0.556	93.409	124.925
59000.000	46.505	0.539	94.994	127.144
60000.000	46.486	0.522	96.580	129.363

	RANGE	BEARING
33.390 IS THE MAXIMUM PEAK CONCENTRATION	3000.2	62.3

1***

ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM PAGE 11
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1354 EST 18 MAR 1996
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----- MAXIMUM CENTERLINE CALCULATIONS -----

CONCENTRATION OF HCL AT A HEIGHT OF 849.7 METERS
DOWNWIND FROM A TITAN IV NORMAL LAUNCH
CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 2890.7 METERS

RANGE FROM PAD (METERS)	BEARING FROM PAD (DEGREES)	TOTAL DOSAGE (PPM SEC)	CLOUD ARRIVAL TIME (MIN)	CLOUD DEPARTURE TIME (MIN)
3000.187	62.319	2720.136	3.517	7.262
4000.116	58.227	2376.100	3.826	9.164
5000.000	55.565	1950.769	5.889	11.044
6000.015	54.097	1602.337	7.933	12.919
7000.007	52.781	1327.476	9.975	14.792
8000.003	51.952	1106.233	12.006	16.657
9000.002	51.192	928.838	14.037	19.174
10000.001	50.647	787.828	16.063	21.270
11000.001	50.258	675.488	18.085	23.363
12000.001	49.985	585.313	20.103	25.456
13000.000	49.532	512.886	21.944	27.557
14000.000	49.417	454.252	23.537	29.650
15000.000	49.083	406.841	25.135	31.751
16000.000	48.791	367.866	26.732	33.852
17000.000	48.813	335.563	28.320	35.945
18000.000	48.586	308.904	29.915	38.047
19000.000	48.383	286.341	31.508	40.149
20000.000	48.200	267.021	33.101	42.251
21000.000	48.034	250.283	34.693	44.353
22000.000	48.170	235.434	36.277	46.446
23000.000	48.034	222.602	37.868	48.549
24000.000	47.909	211.125	39.458	50.652
25000.000	47.794	200.776	41.048	52.755
26000.000	47.688	191.380	42.638	54.858
27000.000	47.589	182.802	44.227	56.961
28000.000	47.498	174.932	45.816	59.064
29000.000	47.413	167.685	47.404	61.167
30000.000	47.334	160.988	48.993	63.271
31000.000	47.260	154.781	50.581	65.375
32000.000	47.484	148.767	52.161	67.468
33000.000	47.419	143.453	53.749	69.572
34000.000	47.358	138.493	55.336	71.701
35000.000	47.301	133.857	56.924	73.917
36000.000	47.246	129.515	58.511	76.134
37000.000	47.195	125.444	60.098	78.350
38000.000	47.146	121.621	61.685	80.567
39000.000	47.100	118.026	63.272	82.783

VERSION 7.05 AT KSC
1354 EST 18 MAR 1996
launch time: 0838 EDT 10 JUL 1995
RAWINSONDE ASCENT NUMBER 0, 1138 Z 10 JUL 95 T -1.0 HR
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----- MAXIMUM CENTERLINE CALCULATIONS -----

CONCENTRATION OF HCL AT A HEIGHT OF 849.7 METERS
DOWNWIND FROM A TITAN IV NORMAL LAUNCH
CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 2890.7 METERS

RANGE FROM PAD (METERS)	BEARING FROM PAD (DEGREES)	TOTAL DOSAGE (PPM SEC)	CLOUD ARRIVAL TIME (MIN)	CLOUD DEPARTURE TIME (MIN)
40000.000	47.056	114.642	64.859	85.000
41000.000	47.015	111.452	66.446	87.217
42000.000	46.975	108.441	68.032	89.435
43000.000	46.937	105.596	69.619	91.652
44000.000	46.901	102.904	71.205	93.870
45000.000	46.866	100.355	72.791	96.087
46000.000	46.833	97.938	74.378	98.305
47000.000	46.801	95.644	75.964	100.523
48000.000	46.771	93.463	77.550	102.741
49000.000	46.742	91.388	79.136	104.959
50000.000	46.714	89.411	80.722	107.177
51000.000	46.687	87.526	82.308	109.395
52000.000	46.662	85.728	83.894	111.614
53000.000	46.637	84.007	85.480	113.832
54000.000	46.613	82.362	87.066	116.051
55000.000	46.590	80.785	88.651	118.269
56000.000	46.568	79.273	90.237	120.488
57000.000	46.546	77.821	91.823	122.707
58000.000	46.525	76.426	93.409	124.925
59000.000	46.505	75.085	94.994	127.144
60000.000	46.486	73.793	96.580	129.363

	RANGE	BEARING
2720.136 IS THE MAXIMUM TOTAL DOSAGE	3000.2	62.3

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1***************************************************************************
           ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM        PAGE   13
                      VERSION 7.05 AT  KSC
                      1354 EST 18 MAR 1996
                 launch time:  0838 EDT 10 JUL 1995
     RAWINSONDE ASCENT NUMBER        0, 1138    Z 10 JUL    95  T  -1.0 HR
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----- MAXIMUM CENTERLINE CALCULATIONS -----

CONCENTRATION OF HCL AT A HEIGHT OF 849.7 METERS
DOWNWIND FROM A TITAN IV NORMAL LAUNCH
CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 2890.7 METERS

RANGE FROM PAD (METERS)	BEARING FROM PAD (DEGREES)	30.0 MIN. MEAN CONCEN- TRATION (PPM)	CLOUD ARRIVAL TIME (MIN)	CLOUD DEPARTURE TIME (MIN)
3000.187	62.319	1.511	3.517	7.262
4000.116	58.227	1.320	3.826	9.164
5000.000	55.565	1.084	5.889	11.044
6000.015	54.097	0.890	7.933	12.919
7000.007	52.781	0.737	9.975	14.792
8000.003	51.952	0.615	12.006	16.657
9000.002	51.192	0.516	14.037	19.174
10000.001	50.647	0.438	16.063	21.270
11000.001	50.258	0.375	18.085	23.363
12000.001	49.985	0.325	20.103	25.456
13000.000	49.532	0.285	21.944	27.557
14000.000	49.417	0.252	23.537	29.650
15000.000	49.083	0.226	25.135	31.751
16000.000	48.791	0.204	26.732	33.852
17000.000	48.813	0.186	28.320	35.945
18000.000	48.586	0.172	29.915	38.047
19000.000	48.383	0.159	31.508	40.149
20000.000	48.200	0.148	33.101	42.251
21000.000	48.034	0.139	34.693	44.353
22000.000	48.170	0.131	36.277	46.446
23000.000	48.034	0.124	37.868	48.549
24000.000	47.909	0.117	39.458	50.652
25000.000	47.794	0.112	41.048	52.755
26000.000	47.688	0.106	42.638	54.858
27000.000	47.589	0.102	44.227	56.961
28000.000	47.498	0.097	45.816	59.064
29000.000	47.413	0.093	47.404	61.167
30000.000	47.334	0.089	48.993	63.271
31000.000	47.260	0.086	50.581	65.375
32000.000	47.484	0.083	52.161	67.468
33000.000	47.419	0.080	53.749	69.572
34000.000	47.358	0.077	55.336	71.701
35000.000	47.301	0.074	56.924	73.917
36000.000	47.246	0.072	58.511	76.134
37000.000	47.195	0.070	60.098	78.350
38000.000	47.146	0.068	61.685	80.567

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ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM PAGE 14
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1354 EST 18 MAR 1996
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----- MAXIMUM CENTERLINE CALCULATIONS -----

CONCENTRATION OF HCL AT A HEIGHT OF 849.7 METERS
DOWNWIND FROM A TITAN IV NORMAL LAUNCH
CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 2890.7 METERS

RANGE FROM PAD (METERS)	BEARING FROM PAD (DEGREES)	30.0 MIN. MEAN CONCEN-TRATION (PPM)	CLOUD ARRIVAL TIME (MIN)	CLOUD DEPARTURE TIME (MIN)
39000.000	47.100	0.066	63.272	82.783
40000.000	47.056	0.064	64.859	85.000
41000.000	47.015	0.062	66.446	87.217
42000.000	46.975	0.060	68.032	89.435
43000.000	46.937	0.059	69.619	91.652
44000.000	46.901	0.057	71.205	93.870
45000.000	46.866	0.056	72.791	96.087
46000.000	46.833	0.054	74.378	98.305
47000.000	46.801	0.053	75.964	100.523
48000.000	46.771	0.052	77.550	102.741
49000.000	46.742	0.051	79.136	104.959
50000.000	46.714	0.050	80.722	107.177
51000.000	46.687	0.049	82.308	109.395
52000.000	46.662	0.048	83.894	111.614
53000.000	46.637	0.047	85.480	113.832
54000.000	46.613	0.046	87.066	116.051
55000.000	46.590	0.045	88.651	118.269
56000.000	46.568	0.044	90.237	120.488
57000.000	46.546	0.043	91.823	122.707
58000.000	46.525	0.042	93.409	124.925
59000.000	46.505	0.042	94.994	127.144
60000.000	46.486	0.041	96.580	129.363

	RANGE	BEARING
1.511 IS THE MAXIMUM 30.0 MIN. MEAN CONCENTRATION	3000.2	62.3

*** REEDM HAS TERMINATED

2. Ground-Level HCl Exposure Doses Calculated from T-1.0 Hour Rawinsonde Data

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                 ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM        PAGE    2
                             VERSION 7.05 AT  KSC
                             1813 EST 15 MAR 1996
                       launch time:  0838 EDT 10 JUL 1995
     RAWINSONDE ASCENT NUMBER       0, 1138    Z 10 JUL   95  T  -1.0 HR
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                         ----- PROGRAM OPTIONS -----

 MODEL                                                           CONCENTRATION
 RUN TYPE                                                          OPERATIONAL
 WIND-FIELD TERRAIN EFFECTS MODEL                                         NONE
 LAUNCH VEHICLE                                                       TITAN IV
 LAUNCH TYPE                                                            NORMAL
 LAUNCH COMPLEX NUMBER                                                      41
 TURBULENCE PARAMETERS ARE DETERMINED FROM                  CLIMATOLOGICAL DATA
 SPECIES                                                                   HCL
 CLOUD SHAPE                                                        ELLIPTICAL
 CALCULATION HEIGHT                                                    SURFACE
 PROPELLANT TEMPERATURE (DEG. C)                                         28.38
 CONCENTRATION AVERAGING TIME (SEC.)                                   1800.00
 DECAY COEFFICIENT                                                      0.0000
 ABSORPTION COEFFICIENT (RNG- 0 TO 1,NO ABSORPTION=0)                   0.0000
 DIFFUSION COEFFICIENTS                                     LATERAL     1.0000
                                                            VERTICAL    1.0000
 VEHICLE AIR ENTRAINMENT PARAMETER                          GAMMAE      0.6400
 DOWNWIND EXPANSION DISTANCE (METERS)                       LATERAL     100.00
                                                            VERTICAL    100.00

                           ----- DATA FILES -----

                                INPUT FILES
 RAWINSONDE FILE                                                  k19_1138.raw
 DATA BASE FILE                                                   rdmbase.ksc

                                OUTPUT FILES
 PRINT FILE                                                       k19d1138.sur
 PLOT FILE                                                        k19d1138.u_p
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ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM PAGE 3

VERSION 7.05 AT KSC

1813 EST 15 MAR 1996

launch time: 0838 EDT 10 JUL 1995

RAWINSONDE ASCENT NUMBER 0, 1138 Z 10 JUL 95 T -1.0 HR

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----- METEOROLOGICAL RAWINSONDE DATA -----

RAWINSONDE MSS/MSS
TIME- 1138 Z DATE- 10 JUL 95
ASCENT NUMBER 0

----- T -1.0 HR SOUNDING -----

MET. LEV. NO.	ALTITUDE MSL (FT)	GND (FT)	GND (M)	WIND DIR (DEG)	WIND SPEED (M/S)	(KTS)	TEMP	AIR PTEMP (DEG C)	DPTEMP	AIR PRESS (MB)	AIR RH (%)	H M	INT-ERP
1	16	0.0	0.0	170	1.5	3.0	25.1	26.9	22.8	1014.8	87.0		
2	57	40.6	12.4	187	2.6	5.0	25.3	27.3	22.9	1013.4	86.6		**
3	97	81.2	24.7	204	3.6	7.0	25.4	27.5	22.9	1012.0	86.1		**
4	138	121.8	37.1	221	4.6	9.0	25.6	27.8	23.0	1010.5	85.6		**
5	178	162.4	49.5	238	5.7	11.0	25.7	28.1	23.0	1009.1	85.1		**
6	219	203.0	61.9	255	6.7	13.0	25.9	28.5	23.1	1007.7	85.0		
7	293	277.3	84.5	255	6.7	13.0	26.0	28.7	22.7	1005.1	81.9		**
8	368	351.7	107.2	255	6.7	13.0	26.1	28.9	22.2	1002.6	79.3		**
9	442	426.0	129.8	255	6.7	13.0	26.2	29.2	21.8	1000.0	77.0		
10	533	517.0	157.6	255	6.9	13.5	26.4	29.5	21.3	996.9	73.6		**
11	624	608.0	185.3	255	7.2	14.0	26.5	29.9	20.7	993.8	71.0		
12	812	796.0	242.6	255	7.4	14.3	26.0	29.9	20.4	987.4	71.1		**
13	1000	984.0	299.9	254	7.5	14.6	25.6	30.0	20.1	981.0	72.0		
14	1309	1292.7	394.0	251	7.8	15.1	24.9	30.2	19.3	970.6	71.2		**
15	1617	1601.3	488.1	249	8.0	15.5	24.3	30.3	18.6	960.2	70.6		**
16	1926	1910.0	582.2	246	8.2	16.0	23.6	30.5	17.8	950.0	70.0		
17	2000	1984.0	604.7	245	8.2	16.0	23.5	30.6	17.5	947.7	69.0		
18	2500	2484.0	757.1	239	8.7	17.0	22.5	31.0	16.3	931.3	68.0		**
19	3000	2984.0	909.5	232	9.3	18.0	21.6	31.4	15.1	915.2	66.0		
20	3472	3456.0	1053.4	228	9.8	19.0	20.8	32.0	14.8	900.0	68.0		
21	4000	3984.0	1214.3	224	10.0	19.5	19.8	32.5	13.9	883.6	69.0		
22	5000	4984.0	1519.1	218	10.3	20.0	17.7	33.4	13.3	852.9	76.0		
23	5088	5072.0	1545.9	218	10.3	20.0	17.4	33.4	13.1	850.0	76.0		
24	5602	5586.0	1702.6	216	10.3	20.0	16.4	33.8	11.9	834.9	75.0		
25	6000	5984.0	1823.9	215	10.4	20.2	15.8	34.3	10.8	823.1	73.0		
26	6153	6137.0	1870.6	214	10.3	20.0	15.5	34.4	10.4	818.6	72.0		
27	6782	6766.0	2062.3	214	10.3	20.0	14.1	34.7	7.4	800.0	64.0		
28	7000	6984.0	2128.7	214	10.1	19.7	13.7	34.8	6.4	794.1	61.0		
29	7500	7484.0	2281.1	215	9.7	18.9	13.0	35.4	2.6	779.9	49.7		**
30	8000	7984.0	2433.5	216	9.3	18.1	12.4	36.1	-1.3	765.9	40.0		
31	8400	8384.0	2555.4	217	8.7	17.0	12.4	37.0	-6.9	754.9	25.0		
32	8561	8545.0	2604.5	217	8.7	17.0	12.1	37.3	-8.0	750.0	24.0		
33	9000	8984.0	2738.3	218	8.2	15.9	11.3	37.7	-10.5	738.6	21.0		
34	9500	9484.0	2890.7	220	7.9	15.4	10.4	38.3	-11.3	725.2	21.5	*	**

* - INDICATES THE CALCULATED TOP OF THE SURFACE MIXING LAYER
** - INDICATES THAT DATA IS LINEARLY INTERPOLATED FROM INPUT METEOROLOGY

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1*************************************************************************
             ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM        PAGE    4
                         VERSION 7.05 AT  KSC
                         1813 EST 15 MAR 1996
                  launch time:  0838 EDT 10 JUL 1995
     RAWINSONDE ASCENT NUMBER       0, 1138   Z 10 JUL   95  T  -1.0 HR
*************************************************************************

                ----- METEOROLOGICAL RAWINSONDE DATA -----

  SURFACE AIR DENSITY (GM/M**3)                                    1173.08
  DEFAULT CALCULATED MIXING LAYER HEIGHT (M)                       2890.72
  CLOUD COVER IN TENTHS OF CELESTIAL DOME                              0.0
  CLOUD CEILING (M)                                                 9999.0
                       ----- PLUME RISE DATA -----

 EXHAUST RATE OF MATERIAL-             (GRAMS/SEC)          4.24344E+06
 TOTAL MATERIAL OUTPUT-                (GRAMS)              5.36146E+08
 HEAT OUTPUT PER GRAM-                 (CALORIES)             1555.5800
 VEHICLE RISE TIME PARAMETERS-         (TK=(A*Z**B)+C)   A=      0.8678
                                                         B=      0.4500
                                                         C=      0.0000
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VERSION 7.05 AT KSC
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----- EXHAUST CLOUD -----

MET. LAYER NO.	TOP OF LAYER (METERS)	CLOUD RISE TIME (SECONDS)	CLOUD RISE RANGE (METERS)	CLOUD RISE BEARING (DEGREES)	STABILIZED CLOUD RANGE (METERS)	STABILIZED CLOUD BEARING (DEGREES)
1	12.4	2.4	2.1	356.1	0.0	0.0
2	24.7	3.7	6.7	3.9	0.0	0.0
3	37.1	5.0	11.2	12.5	0.0	0.0
4	49.5	6.2	16.4	22.4	0.0	0.0
5	61.9	7.5	22.4	33.2	0.0	0.0
6	84.5	10.0	32.9	47.4	0.0	0.0
7	107.2	12.7	49.0	56.9	0.0	0.0
8	129.8	15.7	67.4	61.9	0.0	0.0
9	157.6	19.7	90.5	65.3	0.0	0.0
10	185.3	24.2	119.6	67.7	0.0	0.0
11	242.6	34.7	173.2	69.9	0.0	0.0
12	299.9	46.8	256.4	71.4	0.0	0.0
13	394.0	70.2	390.4	72.2	2615.3	72.6
14	488.1	98.6	590.9	71.8	2662.8	70.4
15	582.2	132.9	841.1	70.9	2696.6	68.4
16	604.7	142.4	1019.9	70.1	2824.2	67.2
17	757.1	225.0	1401.9	68.3	2559.0	65.3
18	909.5	361.8 *	2961.3	62.5	2961.3	62.5
19	1053.4	361.8 *	2961.3	62.5	2961.3	62.5
20	1214.3	361.8 *	2961.3	62.5	2961.3	62.5
21	1519.1	361.8 *	2961.3	62.5	2961.3	62.5
22	1545.9	361.8 *	2961.3	62.5	2961.3	62.5
23	1702.6	361.8 *	2961.3	62.5	2961.3	62.5
24	1823.9	361.8 *	2961.3	62.5	2961.3	62.5
25	1870.6	361.8 *	2961.3	62.5	2961.3	62.5
26	2062.3	361.8 *	2961.3	62.5	2961.3	62.5
27	2128.7	361.8 *	2961.3	62.5	2961.3	62.5
28	2281.1	361.8 *	2961.3	62.5	2961.3	62.5
29	2433.5	361.8 *	2961.3	62.5	2961.3	62.5
30	2555.4	361.8 *	2961.3	62.5	2961.3	62.5
31	2604.5	361.8 *	2961.3	62.5	2961.3	62.5
32	2738.3	361.8 *	2961.3	62.5	2961.3	62.5
33	2890.7	361.8 *	2961.3	62.5	2961.3	62.5

* - INDICATES CLOUD STABILIZATION TIME WAS USED

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ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM PAGE 6

VERSION 7.05 AT KSC

1813 EST 15 MAR 1996

launch time: 0838 EDT 10 JUL 1995

RAWINSONDE ASCENT NUMBER 0, 1138 Z 10 JUL 95 T -1.0 HR

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----- EXHAUST CLOUD -----

MET. LAYER NO.	TOP OF LAYER (METERS)		LAYER SOURCE STRENGTH (GRAMS)	CLOUD UPDRAFT VELOCITY (M/S)	CLOUD RADIUS (METERS)	STD. DEVIATION MATERIAL DIST. ALONGWIND (METERS)	CROSSWIND (METERS)
1	12.4		0.00000E+00	8.3	0.0	0.0	0.0
2	24.7		0.00000E+00	9.8	0.0	0.0	0.0
3	37.1		0.00000E+00	10.0	0.0	0.0	0.0
4	49.5		0.00000E+00	9.8	0.0	0.0	0.0
5	61.9		0.00000E+00	9.5	0.0	0.0	0.0
6	84.5		0.00000E+00	8.7	0.0	0.0	0.0
7	107.2		0.00000E+00	8.0	0.0	0.0	0.0
8	129.8		0.00000E+00	7.3	0.0	0.0	0.0
9	157.6		0.00000E+00	6.5	0.0	0.0	0.0
10	185.3		0.00000E+00	5.9	0.0	0.0	0.0
11	242.6		0.00000E+00	5.0	0.0	0.0	0.0
12	299.9		0.00000E+00	4.4	0.0	0.0	0.0
13	394.0		1.40158E+06	3.6	354.5	165.2	165.2
14	488.1		4.29334E+06	3.0	459.8	214.3	214.3
15	582.2		6.58804E+06	2.5	528.7	246.3	246.3
16	604.7		1.85419E+06	2.3	559.2	260.6	260.6
17	757.1		1.44560E+07	1.4	591.6	275.7	275.7
18	909.5	*	1.83791E+07	0.0	614.9	286.6	286.6
19	1053.4	*	1.96249E+07	0.0	600.9	280.0	280.0
20	1214.3	*	1.78103E+07	0.0	545.6	254.2	254.2
21	1519.1	*	1.40065E+07	0.0	333.3	155.3	155.3
22	1545.9	*	7.86512E+05	0.0	199.9	93.2	93.2
23	1702.6	*	4.45076E+06	0.0	199.9	93.2	93.2
24	1823.9	*	3.29360E+06	0.0	199.9	93.2	93.2
25	1870.6	*	1.23396E+06	0.0	199.9	93.2	93.2
26	2062.3	*	4.90302E+06	0.0	199.9	93.2	93.2
27	2128.7	*	1.64040E+06	0.0	199.9	93.2	93.2
28	2281.1	*	3.65900E+06	0.0	199.9	93.2	93.2
29	2433.5	*	3.52687E+06	0.0	199.9	93.2	93.2
30	2555.4	*	2.73490E+06	0.0	199.9	93.2	93.2
31	2604.5	*	1.08051E+06	0.0	199.9	93.2	93.2
32	2738.3	*	2.89053E+06	0.0	199.9	93.2	93.2
33	2890.7	*	3.19907E+06	0.0	199.9	93.2	93.2

* - INDICATES CLOUD STABILIZATION TIME WAS USED

----- CLOUD STABILIZATION -----

CALCULATION HEIGHT	(METERS)	0.00
STABILIZATION HEIGHT	(METERS)	849.68
STABILIZATION TIME	(SECS)	361.82
FIRST MIXING LAYER HEIGHT-	(METERS)	TOP = 2890.72
		BASE= 0.00
SIGMAR(AZ) AT THE SURFACE	(DEGREES)	13.9121
SIGMER(EL) AT THE SURFACE	(DEGREES)	3.2984

MET. LAYER NO.	WIND SPEED (M/SEC)	WIND SPEED SHEAR (M/SEC)	WIND DIRECTION (DEG)	WIND DIRECTION SHEAR (DEG)	SIGMA OF AZI ANG (DEG)	SIGMA OF ELE ANG (DEG)
1	2.21	1.03	178.50	17.00	12.0609	4.0849
2	3.09	1.03	195.50	17.00	9.7925	5.1476
3	4.12	1.03	212.50	17.00	9.1472	5.5998
4	5.14	1.03	229.50	17.00	8.7642	5.9074
5	6.17	1.03	246.50	17.00	8.4926	6.1453
6	6.69	0.00	255.00	0.00	8.2183	6.4065
7	6.69	0.00	255.00	0.00	6.3512	5.2602
8	6.69	0.00	255.00	0.00	4.5988	3.9225
9	6.82	0.26	255.00	0.00	4.4730	3.8151
10	7.07	0.26	255.00	0.00	4.3276	3.6911
11	7.28	0.15	254.75	-0.50	4.2208	3.6000
12	7.43	0.15	254.25	-0.50	4.1228	3.5164
13	7.63	0.24	252.67	-2.67	4.0070	3.4177
14	7.87	0.24	250.00	-2.67	3.8865	3.3149
15	8.11	0.24	247.33	-2.67	3.7998	3.2409
16	8.23	0.00	245.50	-1.00	3.7160	3.1695
17	8.49	0.51	241.75	-6.50	3.5558	3.0328
18	9.00	0.51	235.25	-6.50	3.3576	2.8638
19	9.52	0.51	230.00	-4.00	3.1997	2.7291
20	9.90	0.26	226.00	-4.00	3.0956	2.6403
21	10.16	0.26	221.00	-6.00	3.0365	2.5899
22	10.29	0.00	218.00	0.00	3.0172	2.5734
23	10.29	0.00	217.00	-2.00	3.0097	2.5671
24	10.34	0.10	215.50	-1.00	3.0022	2.5607
25	10.34	-0.10	214.50	-1.00	3.0097	2.5671
26	10.29	0.00	214.00	0.00	3.0287	2.5832
27	10.21	-0.15	214.00	0.00	3.0840	2.6305
28	9.93	-0.41	214.50	1.00	3.0768	2.6338
29	9.52	-0.41	215.50	1.00	2.7588	2.3986
30	9.03	-0.57	216.50	1.00	2.3205	2.0683

----- CALCULATED METEOROLOGICAL LAYER PARAMETERS -----

MET. LAYER NO.	WIND SPEED (M/SEC)	WIND SPEED SHEAR (M/SEC)	WIND DIRECTION (DEG)	WIND DIRECTION SHEAR (DEG)	SIGMA OF AZI ANG (DEG)	SIGMA OF ELE ANG (DEG)
31	8.75	0.00	217.00	0.00	1.9660	1.8009
32	8.46	-0.57	217.50	1.00	1.5065	1.4465
33	8.05	-0.26	218.75	1.50	1.2303	1.2303

TRANSITION LAYER NUMBER- 1

VALUE AT	HEIGHT (METERS)	TEMP. (DEG K)	WIND SPEED (M/SEC)	WIND SPEED SHEAR (M/SEC)	WIND DIR. (DEG)	WIND DIR. SHEAR (DEG)	SIGMA AZI. (DEG)	SIGMA ELE. (DEG)
TOP-	2890.72	311.43	7.92		219.50		1.2303	1.2303
LAYER-			8.82	1.06	225.66	9.11	3.2403	2.7246
BOTTOM-	0.00	300.10	1.54		170.00		13.9121	3.2984

----- MAXIMUM CENTERLINE CALCULATIONS -----

CONCENTRATION OF HCL AT A HEIGHT OF 0.0 METERS
DOWNWIND FROM A TITAN IV NORMAL LAUNCH
CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 2890.7 METERS

RANGE FROM PAD (METERS)	BEARING FROM PAD (DEGREES)	PEAK CONCEN-TRATION (PPM)	CLOUD ARRIVAL TIME (MIN)	CLOUD DEPARTURE TIME (MIN)
5000.102	59.351	0.077	5.767	9.738
6000.038	56.736	0.449	7.843	12.836
7000.016	54.848	1.012	9.905	14.728
8000.007	53.433	1.574	11.956	16.611
9000.004	52.460	2.050	13.995	18.485
10000.002	51.683	2.433	16.028	20.357
11000.001	50.785	2.736	18.068	22.504
12000.001	50.253	2.960	20.095	25.447
13000.000	49.803	3.112	21.937	27.549
14000.000	49.417	3.199	23.537	29.650
15000.000	49.359	3.231	25.128	31.742
16000.000	49.069	3.217	26.725	33.843
17000.000	48.813	3.167	28.320	35.945
18000.000	48.586	3.089	29.915	38.047
19000.000	48.383	2.991	31.508	40.149
20000.000	48.200	2.880	33.101	42.251
21000.000	48.034	2.760	34.693	44.353
22000.000	48.170	2.636	36.277	46.446
23000.000	48.034	2.511	37.868	48.549
24000.000	47.909	2.388	39.458	50.652
25000.000	47.794	2.267	41.048	52.755
26000.000	47.688	2.150	42.638	54.858
27000.000	47.589	2.037	44.227	56.961
28000.000	47.498	1.930	45.816	59.064
29000.000	47.413	1.828	47.404	61.167
30000.000	47.334	1.731	48.993	63.271
31000.000	47.260	1.640	50.581	65.375
32000.000	47.484	1.552	52.161	67.468
33000.000	47.419	1.472	53.749	69.572
34000.000	47.358	1.397	55.336	71.701
35000.000	47.301	1.327	56.924	73.917
36000.000	47.246	1.261	58.511	76.134
37000.000	47.195	1.200	60.098	78.350
38000.000	47.146	1.142	61.685	80.567
39000.000	47.100	1.089	63.272	82.783
40000.000	47.056	1.038	64.859	85.000
41000.000	47.015	0.991	66.446	87.217

----- MAXIMUM CENTERLINE CALCULATIONS -----

CONCENTRATION OF HCL AT A HEIGHT OF 0.0 METERS
DOWNWIND FROM A TITAN IV NORMAL LAUNCH
CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 2890.7 METERS

RANGE FROM PAD (METERS)	BEARING FROM PAD (DEGREES)	PEAK CONCEN-TRATION (PPM)	CLOUD ARRIVAL TIME (MIN)	CLOUD DEPARTURE TIME (MIN)
42000.000	46.975	0.947	68.032	89.435
43000.000	46.937	0.906	69.619	91.652
44000.000	46.901	0.868	71.205	93.870
45000.000	46.866	0.831	72.791	96.087
46000.000	46.833	0.797	74.378	98.305
47000.000	46.801	0.765	75.964	100.523
48000.000	46.771	0.735	77.550	102.741
49000.000	46.742	0.707	79.136	104.959
50000.000	46.714	0.680	80.722	107.177
51000.000	46.687	0.655	82.308	109.395
52000.000	46.662	0.631	83.894	111.614
53000.000	46.637	0.609	85.480	113.832
54000.000	46.613	0.587	87.066	116.051
55000.000	46.590	0.567	88.651	118.269
56000.000	46.568	0.548	90.237	120.488
57000.000	46.546	0.530	91.823	122.707
58000.000	46.525	0.513	93.409	124.925
59000.000	46.505	0.496	94.994	127.144
60000.000	46.486	0.481	96.580	129.363

	RANGE	BEARING
3.231 IS THE MAXIMUM PEAK CONCENTRATION	15000.0	49.4

----- MAXIMUM CENTERLINE CALCULATIONS -----

CONCENTRATION OF HCL AT A HEIGHT OF 0.0 METERS
DOWNWIND FROM A TITAN IV NORMAL LAUNCH
CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 2890.7 METERS

RANGE FROM PAD (METERS)	BEARING FROM PAD (DEGREES)	TOTAL DOSAGE (PPM SEC)	CLOUD ARRIVAL TIME (MIN)	CLOUD DEPARTURE TIME (MIN)
4000.297	62.852	0.010	3.667	5.620
5000.102	59.351	3.774	5.767	9.738
6000.038	56.736	24.138	7.843	12.836
7000.016	54.848	59.635	9.905	14.728
8000.007	53.433	99.630	11.956	16.611
9000.054	52.209	137.001	13.995	18.485
10000.073	51.426	169.830	16.028	20.357
11000.001	50.785	197.312	18.068	22.504
12000.001	50.253	218.611	20.095	25.447
13000.000	49.803	233.747	21.937	27.549
14000.000	49.417	243.164	23.537	29.650
15000.161	49.084	247.666	25.128	31.742
16000.000	49.069	248.387	26.725	33.843
17000.000	48.813	246.127	28.320	35.945
18000.000	48.586	241.649	29.915	38.047
19000.000	48.383	235.619	31.508	40.149
20000.000	48.200	228.562	33.101	42.251
21000.000	48.034	220.880	34.693	44.353
22000.000	48.170	212.825	36.277	46.446
23000.000	48.034	204.830	37.868	48.549
24000.000	47.909	196.874	39.458	50.652
25000.000	47.794	189.069	41.048	52.755
26000.000	47.688	181.493	42.638	54.858
27000.000	47.589	174.196	44.227	56.961
28000.000	47.498	167.210	45.816	59.064
29000.000	47.413	160.554	47.404	61.167
30000.000	47.334	154.235	48.993	63.271
31000.000	47.260	148.254	50.581	65.375
32000.000	47.484	142.390	52.161	67.468
33000.000	47.419	137.114	53.749	69.572
34000.000	47.358	132.146	55.336	71.701
35000.000	47.301	127.471	56.924	73.917
36000.000	47.246	123.077	58.511	76.134
37000.000	47.195	118.948	60.098	78.350
38000.000	47.146	115.068	61.685	80.567
39000.000	47.100	111.423	63.272	82.783
40000.000	47.056	107.998	64.859	85.000

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ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM PAGE 12
VERSION 7.05 AT KSC
1813 EST 15 MAR 1996
launch time: 0838 EDT 10 JUL 1995
RAWINSONDE ASCENT NUMBER 0, 1138 Z 10 JUL 95 T -1.0 HR

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----- MAXIMUM CENTERLINE CALCULATIONS -----

CONCENTRATION OF HCL AT A HEIGHT OF 0.0 METERS
DOWNWIND FROM A TITAN IV NORMAL LAUNCH
CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 2890.7 METERS

RANGE FROM PAD (METERS)	BEARING FROM PAD (DEGREES)	TOTAL DOSAGE (PPM SEC)	CLOUD ARRIVAL TIME (MIN)	CLOUD DEPARTURE TIME (MIN)
41000.000	47.015	104.777	66.446	87.217
42000.000	46.975	101.747	68.032	89.435
43000.000	46.937	98.894	69.619	91.652
44000.000	46.901	96.206	71.205	93.870
45000.000	46.866	93.671	72.791	96.087
46000.000	46.833	91.278	74.378	98.305
47000.000	46.801	89.016	75.964	100.523
48000.000	46.771	86.876	77.550	102.741
49000.000	46.742	84.849	79.136	104.959
50000.000	46.714	82.927	80.722	107.177
51000.000	46.687	81.100	82.308	109.395
52000.000	46.662	79.364	83.894	111.614
53000.000	46.637	77.712	85.480	113.832
54000.000	46.613	76.135	87.066	116.051
55000.000	46.590	74.633	88.651	118.269
56000.000	46.568	73.197	90.237	120.488
57000.000	46.546	71.822	91.823	122.707
58000.000	46.525	70.505	93.409	124.925
59000.000	46.505	69.241	94.994	127.144
60000.000	46.486	68.027	96.580	129.363

	RANGE	BEARING
248.387 IS THE MAXIMUM TOTAL DOSAGE	16000.0	49.1

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ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM PAGE 13
VERSION 7.05 AT KSC
1813 EST 15 MAR 1996
launch time: 0838 EDT 10 JUL 1995
RAWINSONDE ASCENT NUMBER 0, 1138 Z 10 JUL 95 T -1.0 HR
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----- MAXIMUM CENTERLINE CALCULATIONS -----

CONCENTRATION OF HCL AT A HEIGHT OF 0.0 METERS
DOWNWIND FROM A TITAN IV NORMAL LAUNCH
CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 2890.7 METERS

RANGE FROM PAD (METERS)	BEARING FROM PAD (DEGREES)	30.0 MIN. MEAN CONCEN-TRATION (PPM)	CLOUD ARRIVAL TIME (MIN)	CLOUD DEPARTURE TIME (MIN)
5000.102	59.351	0.002	5.767	9.738
6000.038	56.736	0.013	7.843	12.836
7000.016	54.848	0.033	9.905	14.728
8000.007	53.433	0.055	11.956	16.611
9000.054	52.209	0.076	13.995	18.485
10000.073	51.426	0.094	16.028	20.357
11000.001	50.785	0.110	18.068	22.504
12000.001	50.253	0.121	20.095	25.447
13000.000	49.803	0.130	21.937	27.549
14000.000	49.417	0.135	23.537	29.650
15000.161	49.084	0.138	25.128	31.742
16000.000	49.069	0.138	26.725	33.843
17000.000	48.813	0.137	28.320	35.945
18000.000	48.586	0.134	29.915	38.047
19000.000	48.383	0.131	31.508	40.149
20000.000	48.200	0.127	33.101	42.251
21000.000	48.034	0.123	34.693	44.353
22000.000	48.170	0.118	36.277	46.446
23000.000	48.034	0.114	37.868	48.549
24000.000	47.909	0.109	39.458	50.652
25000.000	47.794	0.105	41.048	52.755
26000.000	47.688	0.101	42.638	54.858
27000.000	47.589	0.097	44.227	56.961
28000.000	47.498	0.093	45.816	59.064
29000.000	47.413	0.089	47.404	61.167
30000.000	47.334	0.086	48.993	63.271
31000.000	47.260	0.082	50.581	65.375
32000.000	47.484	0.079	52.161	67.468
33000.000	47.419	0.076	53.749	69.572
34000.000	47.358	0.073	55.336	71.701
35000.000	47.301	0.071	56.924	73.917
36000.000	47.246	0.068	58.511	76.134
37000.000	47.195	0.066	60.098	78.350
38000.000	47.146	0.064	61.685	80.567
39000.000	47.100	0.062	63.272	82.783
40000.000	47.056	0.060	64.859	85.000

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ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM PAGE 14
VERSION 7.05 AT KSC
1813 EST 15 MAR 1996
launch time: 0838 EDT 10 JUL 1995
RAWINSONDE ASCENT NUMBER 0, 1138 Z 10 JUL 95 T -1.0 HR

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----- MAXIMUM CENTERLINE CALCULATIONS -----

CONCENTRATION OF HCL AT A HEIGHT OF 0.0 METERS
DOWNWIND FROM A TITAN IV NORMAL LAUNCH
CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 2890.7 METERS

RANGE FROM PAD (METERS)	BEARING FROM PAD (DEGREES)	30.0 MIN. MEAN CONCEN-TRATION (PPM)	CLOUD ARRIVAL TIME (MIN)	CLOUD DEPARTURE TIME (MIN)
41000.000	47.015	0.058	66.446	87.217
42000.000	46.975	0.057	68.032	89.435
43000.000	46.937	0.055	69.619	91.652
44000.000	46.901	0.053	71.205	93.870
45000.000	46.866	0.052	72.791	96.087
46000.000	46.833	0.051	74.378	98.305
47000.000	46.801	0.049	75.964	100.523
48000.000	46.771	0.048	77.550	102.741
49000.000	46.742	0.047	79.136	104.959
50000.000	46.714	0.046	80.722	107.177
51000.000	46.687	0.045	82.308	109.395
52000.000	46.662	0.044	83.894	111.614
53000.000	46.637	0.043	85.480	113.832
54000.000	46.613	0.042	87.066	116.051
55000.000	46.590	0.041	88.651	118.269
56000.000	46.568	0.041	90.237	120.488
57000.000	46.546	0.040	91.823	122.707
58000.000	46.525	0.039	93.409	124.925
59000.000	46.505	0.038	94.994	127.144
60000.000	46.486	0.038	96.580	129.363

	RANGE	BEARING
0.138 IS THE MAXIMUM 30.0 MIN. MEAN CONCENTRATION	16000.0	49.1

*** REEDM HAS TERMINATED

Appendix D- Meteorological Data Measured at CCAS Before and After the #K19 Launch

[Material in this Appendix was contributed by Randy Evans of Ensco, Inc.'s Applied Meteorology Unit.]

Meteorological data were measured at a number of CCAS monitoring locations prior to launch and during development and dispersion of the launch cloud. Representative data of three types are tabulated here. Data are first presented for meteorological measurements performed at various Zulu times (TIME) at numerous meteorological towers [designated by their latitudinal and longitudinal positions in degrees (LAT and LON, respectively)] at various elevations (Z) in feet. It is noted that the #K19 launch occurred at 12:38 Zulu time (Zulu time is EDT + 4 hours). Data are next presented on the wind direction in degrees azimuth (DIR), the wind speed in knots (SPD), and the ambient and dew point temperatures in degrees Fahrenheit (T and TD, respectively) at these locations.

Rawinsonde data collected at various Zulu times are presented next. Here altitude (ALT) is expressed in geometric feet, I/R is a measure of the refractive index of air, V/S is the speed of sound in air in knots at the indicated altitude, VPS the saturation vapor pressure of water at the temperature measured at the given altitude, and PW is the precipitable water in the vertical column of air leading up to the altitude indicated.

Doppler radar wind profiler data are presented third. These data were determined at False Cape (latitude 28.60°, longitude 80.59°). Virtual temperature, wind speed, and wind direction data are tabulated as a function of elevation (height) in km and time (Zulu). [In a system of moist air, virtual temperature corresponds to the temperature of dry air that would have the same pressure and density as the moist air. Virtual temperature is approximated by the equation: $T_v = (1 + 0.61q)T$, where T is the temperature, and q is the specific humidity.] It should be noted that the Doppler radar data should be used with caution. The Doppler radar system at False Cape has been newly installed and is under evaluation. The system has not yet been certified as an operational system.

1. Tower Data

METEOROLOGICAL TOWER DATA AT 11:10:00 ZULU TIME (T - 1 hour and 28 minutes)

DAY	TIME	LAT	LON	Z	DIR	SPD	PSPD	T	TD
95191	111000	28.4338	80.5734	6				74	
95191	111000	28.4338	80.5734	12	208	0.0	1.0		
95191	111000	28.4338	80.5734	54	243	2.9	4.1	77	
95191	111000	28.4598	80.5267	6				75	
95191	111000	28.4598	80.5267	12	254	2.9	4.1		
95191	111000	28.4598	80.5267	54	252	6.0	8.0	77	
95191	111000	28.4466	80.5652	6					
95191	111000	28.7435	80.7005	6				79	76
95191	111000	28.7435	80.7005	54	221	7.0	8.9		
95191	111000	28.7975	80.7378	6					
95191	111000	28.7975	80.7378	54					
95191	111000	28.4721	80.5393	6					
95191	111000	28.4721	80.5393	90	249	6.0	7.0		
95191	111000	28.5622	80.5785	6					
95191	111000	28.5622	80.5785	54			0.0		
95191	111000	28.5836	80.5842	6					
95191	111000	28.5836	80.5842	54	216	4.1	4.1		
95191	111000	28.5130	80.5613	6				76	76
95191	111000	28.5130	80.5613	12	244	1.0	1.9		
95191	111000	28.5130	80.5613	54	243	4.1	5.1	78	
95191	111000	28.5130	80.5613	162	244	7.0	8.9		
95191	111000	28.5130	80.5613	204	240	8.0	9.9	79	
95191	111000	28.5130	80.5613	6				76	73
95191	111000	28.5130	80.5613	12	240	1.0	1.9		
95191	111000	28.5130	80.5613	54	239	4.1	6.0	78	
95191	111000	28.5130	80.5613	162	246	7.0	8.9		
95191	111000	28.5130	80.5613	204	247	8.0	9.9	79	
95191	111000	28.5358	80.5747	6				78	
95191	111000	28.5358	80.5747	12	240	4.1	6.0		
95191	111000	28.5358	80.5747	54	238	6.0	8.0	78	
95191	111000	28.6141	80.6203	6				76	
95191	111000	28.6141	80.6203	12	250	1.0	1.9		
95191	111000	28.6141	80.6203	54	220	2.9	4.1	77	
95191	111000	28.4048	80.6519	6				78	76
95191	111000	28.4048	80.6519	54	258	5.1	6.0		
95191	111000	28.4600	80.5711	6				73	
95191	111000	28.4600	80.5711	12	0	0.0	0.0		
95191	111000	28.4600	80.5711	54	253	2.9	4.1	77	
95191	111000	28.6027	80.6414	6				76	
95191	111000	28.6027	80.6414	12	251	1.0	2.9		
95191	111000	28.6027	80.6414	54	229	5.1	7.0	77	
95191	111000	28.6105	80.6069	6					72
95191	111000	28.6105	80.6069	60	217	5.1	6.0	77	
95191	111000	28.6057	80.6016	6				77	75
95191	111000	28.6057	80.6016	60	216	5.1	6.0	77	

METEOROLOGICAL TOWER DATA AT 11:10:00 ZULU TIME (T - 1 hour and 28 minutes) (continued)

DAY	TIME	LAT	LON	Z	DIR	SPD	PSPD	T	TD
95191	111000	28.6294	80.6235	6					74
95191	111000	28.6294	80.6235	60	198	4.1	5.1	77	
95191	111000	28.6248	80.6182	6				76	73
95191	111000	28.6248	80.6182	60	211	6.0	7.0	77	
95191	111000	28.4586	80.5923	6				79	
95191	111000	28.4586	80.5923	12	251	4.1	7.0		
95191	111000	28.4586	80.5923	54	244	6.0	8.0	79	
95191	111000	28.6062	80.6739	6				75	
95191	111000	28.6062	80.6739	12	0	0.0	0.0		
95191	111000	28.6062	80.6739	54	236	2.9	4.1	76	
95191	111000	28.6586	80.6998	6				72	
95191	111000	28.6586	80.6998	12	225	0.0	1.0		
95191	111000	28.6586	80.6998	54	222	4.1	4.1	76	
95191	111000	28.7055	80.7265	6				74	74
95191	111000	28.7055	80.7265	54	191	2.9	5.1		
95191	111000	28.7755	80.8043	6				79	77
95191	111000	28.7755	80.8043	54	221	6.0	8.0		
95191	111000	28.5158	80.6400	6				75	
95191	111000	28.5158	80.6400	12	230	1.9	2.9		
95191	111000	28.5158	80.6400	54	226	2.9	4.1	76	
95191	111000	28.5623	80.6694	6				76	
95191	111000	28.5623	80.6694	12	230	1.9	2.9		
95191	111000	28.5623	80.6694	54	212	2.9	4.1	76	
95191	111000	28.5986	80.6817	6					
95191	111000	28.5986	80.6817	30	233	4.1	6.0		
95191	111000	28.6160	80.6930	6				78	74
95191	111000	28.6160	80.6930	30	232	4.1	4.1		
95191	111000	28.6307	80.7027	6					
95191	111000	28.6307	80.7027	30	205	4.1	4.1		
95191	111000	28.6431	80.7482	6				74	
95191	111000	28.6431	80.7482	12	20	0.0	1.0		
95191	111000	28.6431	80.7482	54	218	2.9	4.1	76	
95191	111000	28.4632	80.6702	6				71	
95191	111000	28.4632	80.6702	12	196	0.0	1.0		
95191	111000	28.4632	80.6702	54	195	2.9	4.1	75	
95191	111000	28.5184	80.6962	6				73	
95191	111000	28.5184	80.6962	12	124	0.0	0.0		
95191	111000	28.5184	80.6962	54	208	2.9	4.1	76	
95191	111000	28.7464	80.8707	6				72	
95191	111000	28.7464	80.8707	54	198	1.9	4.1		
95191	111000	28.4079	80.7604	6				74	
95191	111000	28.4079	80.7604	54	201	1.0	2.9		
95191	111000	28.5272	80.7742	6				76	74
95191	111000	28.5272	80.7742	54	228	6.0	7.0		

METEOROLOGICAL TOWER DATA AT 11:10:00 ZULU TIME (T - 1 hour and 28 minutes) (continued)

DAY	TIME	LAT	LON	Z	DIR	SPD	PSPD	T	TD
95191	111000	28.6056	80.8248	6				73	73
95191	111000	28.6056	80.8248	54	204	1.9	2.9		
95191	111000	28.5697	80.5864	6				79	76
95191	111000	28.5697	80.5864	12	225	1.9	5.1		
95191	111000	28.5697	80.5864	54	232	6.0	8.0	79	
95191	111000	28.5697	80.5864	162	237	7.0	8.0		
95191	111000	28.5697	80.5864	204	237	8.0	8.9	79	
95191	111000	28.5697	80.5864	6				79	78
95191	111000	28.5697	80.5864	12	234	1.9	5.1		
95191	111000	28.5697	80.5864	54	237	6.0	8.0	79	
95191	111000	28.5697	80.5864	162	238	8.0	8.9		
95191	111000	28.5697	80.5864	204	242	8.9	8.9	79	
95191	111000	28.4843	80.7856	6				72	
95191	111000	28.4843	80.7856	54	220	1.9	4.1		
95191	111000	28.6445	80.9034	6					
95191	111000	28.4114	80.9284	6				68	
95191	111000	28.4114	80.9284	54	0	0.0	0.0		
95191	111000	28.4475	80.8538	6					
95191	111000	28.4960	80.8843	6				74	
95191	111000	28.4960	80.8843	54	150	1.9	4.1		
95191	111000	28.5583	80.9132	6					
95191	111000	28.6173	80.9581	6				72	
95191	111000	28.6173	80.9581	54	158	2.9	4.1		
95191	111000	28.6762	80.9987	6					
95191	111000	28.6762	80.9987	54					
95191	111000	28.5231	81.0100	6				69	
95191	111000	28.5231	81.0100	54	213	1.0	1.0		
95191	111000	28.6489	81.0693	6				74	74
95191	111000	28.6489	81.0693	54	162	2.9	4.1		
95191	111000	28.4417	81.0291	6				70	
95191	111000	28.4417	81.0291	54	166	1.9	1.9		
95191	111000	28.6256	80.6571	6				75	75
95191	111000	28.6256	80.6571	12	196	0.0	1.0		
95191	111000	28.6256	80.6571	54	216	2.9	4.1	76	
95191	111000	28.6256	80.6571	162	232	5.1	7.0		
95191	111000	28.6256	80.6571	204	235	6.0	8.0	78	
95191	111000	28.6256	80.6571	295	238	8.0	8.0		
95191	111000	28.6256	80.6571	394	240	8.0	8.0		
95191	111000	28.6256	80.6571	492	243	11.1	11.1	79	
95191	111000	28.6256	80.6571	6				75	76
95191	111000	28.6256	80.6571	12	188	1.0	1.9		
95191	111000	28.6256	80.6571	54	215	2.9	4.1	76	
95191	111000	28.6256	80.6571	162	228	8.0	8.0		
95191	111000	28.6256	80.6571	204	238	8.0	8.9	78	
95191	111000	28.6256	80.6571	295	238	9.9	9.9		
95191	111000	28.6256	80.6571	394	246	11.1	11.1		
95191	111000	28.6256	80.6571	492	247	13.0	13.0	79	

METEOROLOGICAL TOWER DATA AT 11:10:00 ZULU TIME (T - 1 hour and 28 minutes) (continued)

DAY	TIME	LAT	LON	Z	DIR	SPD	PSPD	T	TD
95191	111000	28.3932	80.8211	6				73	
95191	111000	28.3932	80.8211	54	175	1.0	1.9		
95191	111000	28.3382	80.7321	6				72	
95191	111000	28.3382	80.7321	54	217	1.0	1.9		

METEOROLOGICAL TOWER DATA AT 12:00:00 ZULU TIME (T - 38 minutes)

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
95191	120000	28.4338	80.5734	6			81	
95191	120000	28.4338	80.5734	12	253	1.0		
95191	120000	28.4338	80.5734	54	251	2.9	79	
95191	120000	28.4598	80.5267	6			80	
95191	120000	28.4598	80.5267	12	243	4.1		
95191	120000	28.4598	80.5267	54	235	5.1	80	
95191	120000	28.4466	80.5652	6				
95191	120000	28.7435	80.7005	6			80	76
95191	120000	28.7435	80.7005	54	215	6.0		
95191	120000	28.7975	80.7378	6				
95191	120000	28.7975	80.7378	54				
95191	120000	28.4721	80.5393	6				
95191	120000	28.4721	80.5393	90	231	1.0		
95191	120000	28.5622	80.5785	6				
95191	120000	28.5622	80.5785	54	181	0.0		
95191	120000	28.5836	80.5842	6				
95191	120000	28.5836	80.5842	54	237	2.9		
95191	120000	28.5130	80.5613	6			80	77
95191	120000	28.5130	80.5613	12	223	1.9		
95191	120000	28.5130	80.5613	54	240	4.1	80	
95191	120000	28.5130	80.5613	162	243	6.0		
95191	120000	28.5130	80.5613	204	239	6.0	80	
95191	120000	28.5130	80.5613	6			80	74
95191	120000	28.5130	80.5613	12	226	1.9		
95191	120000	28.5130	80.5613	54	236	4.1	80	
95191	120000	28.5130	80.5613	162	245	6.0		
95191	120000	28.5130	80.5613	204	246	6.0	79	
95191	120000	28.5358	80.5747	6			80	
95191	120000	28.5358	80.5747	12	240	2.9		
95191	120000	28.5358	80.5747	54	241	6.0	79	
95191	120000	28.6141	80.6203	6			78	
95191	120000	28.6141	80.6203	12	225	2.9		
95191	120000	28.6141	80.6203	54	224	2.9	78	
95191	120000	28.4048	80.6519	6			80	76
95191	120000	28.4048	80.6519	54	244	6.0		
95191	120000	28.4600	80.5711	6			80	
95191	120000	28.4600	80.5711	12	260	1.9		
95191	120000	28.4600	80.5711	54	248	2.9	79	
95191	120000	28.6027	80.6414	6			79	
95191	120000	28.6027	80.6414	12	229	1.9		
95191	120000	28.6027	80.6414	54	227	4.1	78	
95191	120000	28.6105	80.6069	6				73
95191	120000	28.6105	80.6069	60	218	4.1	80	
95191	120000	28.6057	80.6016	6			80	75
95191	120000	28.6057	80.6016	60	225	2.9	79	

METEOROLOGICAL TOWER DATA AT 12:00:00 ZULU TIME (T - 38 minutes) (Continued)

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
95191	120000	28.6294	80.6235	6				74
95191	120000	28.6294	80.6235	60	204	4.1	79	
95191	120000	28.6248	80.6182	6			80	74
95191	120000	28.6248	80.6182	60	213	4.1	80	
95191	120000	28.4586	80.5923	6			80	
95191	120000	28.4586	80.5923	12	241	4.1		
95191	120000	28.4586	80.5923	54	234	5.1	79	
95191	120000	28.6062	80.6739	6			79	
95191	120000	28.6062	80.6739	12	0	0.0		
95191	120000	28.6062	80.6739	54	232	1.9	79	
95191	120000	28.6586	80.6998	6			78	
95191	120000	28.6586	80.6998	12	227	1.0		
95191	120000	28.6586	80.6998	54	220	1.9	78	
95191	120000	28.7055	80.7265	6			78	75
95191	120000	28.7055	80.7265	54	188	1.9		
95191	120000	28.7755	80.8043	6			80	77
95191	120000	28.7755	80.8043	54	198	5.1		
95191	120000	28.5158	80.6400	6			78	
95191	120000	28.5158	80.6400	12	244	2.9		
95191	120000	28.5158	80.6400	54	273	4.1	78	
95191	120000	28.5623	80.6694	6			79	
95191	120000	28.5623	80.6694	12	216	1.9		
95191	120000	28.5623	80.6694	54	213	2.9	78	
95191	120000	28.5986	80.6817	6				
95191	120000	28.5986	80.6817	30	223	4.1		
95191	120000	28.6160	80.6930	6			81	74
95191	120000	28.6160	80.6930	30	229	2.9		
95191	120000	28.6307	80.7027	6				
95191	120000	28.6307	80.7027	30	216	2.9		
95191	120000	28.6431	80.7482	6			79	
95191	120000	28.6431	80.7482	12	204	1.0		
95191	120000	28.6431	80.7482	54	199	2.9	79	
95191	120000	28.4632	80.6702	6			78	
95191	120000	28.4632	80.6702	12	238	1.9		
95191	120000	28.4632	80.6702	54	221	2.9	78	
95191	120000	28.5184	80.6962	6			77	
95191	120000	28.5184	80.6962	12	204	1.0		
95191	120000	28.5184	80.6962	54	205	1.9	78	
95191	120000	28.7464	80.8707	6			78	76
95191	120000	28.7464	80.8707	54	191	1.0		
95191	120000	28.4079	80.7604	6			77	77
95191	120000	28.4079	80.7604	54	196	2.9		
95191	120000	28.5272	80.7742	6			78	74
95191	120000	28.5272	80.7742	54	225	6.0		

METEOROLOGICAL TOWER DATA AT 12:00:00 ZULU TIME (T - 38 minutes) (Continued)

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
95191	120000	28.6056	80.8248	6			78	74
95191	120000	28.6056	80.8248	54	204	1.9		
95191	120000	28.5697	80.5864	6			80	76
95191	120000	28.5697	80.5864	12	249	1.9		
95191	120000	28.5697	80.5864	54	248	5.1	79	
95191	120000	28.5697	80.5864	162	247	6.0		
95191	120000	28.5697	80.5864	204	248	8.0	80	
95191	120000	28.5697	80.5864	6			80	78
95191	120000	28.5697	80.5864	12	259	1.9		
95191	120000	28.5697	80.5864	54	251	5.1	79	
95191	120000	28.5697	80.5864	162	248	7.0		
95191	120000	28.5697	80.5864	204	252	8.0	79	
95191	120000	28.4843	80.7856	6			77	75
95191	120000	28.4843	80.7856	54	205	2.9		
95191	120000	28.6445	80.9034	6				
95191	120000	28.4114	80.9284	6			76	
95191	120000	28.4114	80.9284	54	0	0.0		
95191	120000	28.4475	80.8538	6				
95191	120000	28.4960	80.8843	6			77	76
95191	120000	28.4960	80.8843	54	164	4.1		
95191	120000	28.5583	80.9132	6				
95191	120000	28.6173	80.9581	6			76	75
95191	120000	28.6173	80.9581	54	162	2.9		
95191	120000	28.6762	80.9987	6				
95191	120000	28.6762	80.9987	54				
95191	120000	28.5231	81.0100	6			75	74
95191	120000	28.5231	81.0100	54	183	1.9		
95191	120000	28.6489	81.0693	6			84	83
95191	120000	28.6489	81.0693	54	159	2.9		
95191	120000	28.4417	81.0291	6			75	74
95191	120000	28.4417	81.0291	54	159	2.9		
95191	120000	28.6256	80.6571	6			80	76
95191	120000	28.6256	80.6571	12	230	1.0		
95191	120000	28.6256	80.6571	54	227	1.9	79	
95191	120000	28.6256	80.6571	162	230	4.1		
95191	120000	28.6256	80.6571	204	233	4.1	80	
95191	120000	28.6256	80.6571	295	238	6.0		
95191	120000	28.6256	80.6571	394	241	7.0		
95191	120000	28.6256	80.6571	492	243	8.9	81	

METEOROLOGICAL TOWER DATA AT 12:00:00 ZULU TIME (T - 38 minutes) (Continued)

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
95191	120000	28.6256	80.6571	6			80	77
95191	120000	28.6256	80.6571	12	219	1.0		
95191	120000	28.6256	80.6571	54	228	1.9	79	
95191	120000	28.6256	80.6571	162	225	5.1		
95191	120000	28.6256	80.6571	204	237	6.0	79	
95191	120000	28.6256	80.6571	295	238	8.0		
95191	120000	28.6256	80.6571	394	247	8.9		
95191	120000	28.6256	80.6571	492	248	11.1	79	
95191	120000	28.3932	80.8211	6			76	76
95191	120000	28.3932	80.8211	54	183	1.9		
95191	120000	28.3382	80.7321	6				
95191	120000	28.3382	80.7321	54				

METEOROLOGICAL TOWER DATA AT 12:35:00 ZULU TIME (T - 3 minutes)

DAY	TIME	LAT	LON	Z	DIR	SPD	PSPD	T	TD
95191	123500	28.4338	80.5734	6				84	
95191	123500	28.4338	80.5734	12	214	4.1	8.0		
95191	123500	28.4338	80.5734	54	232	6.0	8.0	80	
95191	123500	28.4598	80.5267	6				81	
95191	123500	28.4598	80.5267	12	257	4.1	6.0		
95191	123500	28.4598	80.5267	54	245	5.1	7.0	80	
95191	123500	28.4466	80.5652	6					
95191	123500	28.7435	80.7005	6				82	76
95191	123500	28.7435	80.7005	54	218	7.0	8.0		
95191	123500	28.7975	80.7378	6				83	75
95191	123500	28.7975	80.7378	54	224	6.0	8.0		
95191	123500	28.4721	80.5393	6					
95191	123500	28.4721	80.5393	90	234	4.1	7.0		
95191	123500	28.5622	80.5785	6					
95191	123500	28.5622	80.5785	54			0.0		
95191	123500	28.5836	80.5842	6					
95191	123500	28.5836	80.5842	54	219	2.9	4.1		
95191	123500	28.5130	80.5613	6				81	77
95191	123500	28.5130	80.5613	12	228	1.9	5.1		
95191	123500	28.5130	80.5613	54	232	4.1	6.0	81	
95191	123500	28.5130	80.5613	162	227	5.1	7.0		
95191	123500	28.5130	80.5613	204	224	5.1	8.0	80	
95191	123500	28.5130	80.5613	6				81	74
95191	123500	28.5130	80.5613	12	230	1.9	5.1		
95191	123500	28.5130	80.5613	54	230	4.1	7.0	81	
95191	123500	28.5130	80.5613	162	230	5.1	8.0		
95191	123500	28.5130	80.5613	204	232	5.1	8.0	80	
95191	123500	28.5358	80.5747	6				81	
95191	123500	28.5358	80.5747	12	235	4.1	7.0		
95191	123500	28.5358	80.5747	54	230	6.0	8.0	80	
95191	123500	28.6141	80.6203	6				81	
95191	123500	28.6141	80.6203	12	225	4.1	7.0		
95191	123500	28.6141	80.6203	54	226	5.1	7.0	80	
95191	123500	28.4048	80.6519	6				81	77
95191	123500	28.4048	80.6519	54	233	7.0	8.0		
95191	123500	28.4600	80.5711	6				81	
95191	123500	28.4600	80.5711	12	230	1.9	4.1		
95191	123500	28.4600	80.5711	54	225	4.1	7.0	80	
95191	123500	28.6027	80.6414	6				81	
95191	123500	28.6027	80.6414	12	244	1.9	5.1		
95191	123500	28.6027	80.6414	54	236	4.1	7.0	80	
95191	123500	28.6105	80.6069	6					73
95191	123500	28.6105	80.6069	60	203	5.1	6.0	82	
95191	123500	28.6057	80.6016	6				82	76
95191	123500	28.6057	80.6016	60	214	4.1	7.0	81	

METEOROLOGICAL TOWER DATA AT 12:35:00 ZULU TIME (T - 3 minutes) (continued)

DAY	TIME	LAT	LON	Z	DIR	SPD	PSPD	T	TD
95191	123500	28.6294	80.6235	6					73
95191	123500	28.6294	80.6235	60	217	5.1	7.0	81	
95191	123500	28.6248	80.6182	6				82	73
95191	123500	28.6248	80.6182	60	219	6.0	8.0	82	
95191	123500	28.4586	80.5923	6				81	
95191	123500	28.4586	80.5923	12	230	4.1	6.0		
95191	123500	28.4586	80.5923	54	226	4.1	7.0	80	
95191	123500	28.6062	80.6739	6				81	
95191	123500	28.6062	80.6739	12	235	2.9	6.0		
95191	123500	28.6062	80.6739	54	230	4.1	8.0	80	
95191	123500	28.6586	80.6998	6				80	
95191	123500	28.6586	80.6998	12	224	1.9	6.0		
95191	123500	28.6586	80.6998	54	221	4.1	7.0	81	
95191	123500	28.7055	80.7265	6				82	75
95191	123500	28.7055	80.7265	54	206	2.9	6.0		
95191	123500	28.7755	80.8043	6					
95191	123500	28.7755	80.8043	54					
95191	123500	28.5158	80.6400	6				80	
95191	123500	28.5158	80.6400	12	222	4.1	6.0		
95191	123500	28.5158	80.6400	54	240	4.1	7.0	80	
95191	123500	28.5623	80.6694	6				81	
95191	123500	28.5623	80.6694	12	256	4.1	7.0		
95191	123500	28.5623	80.6694	54	240	5.1	8.0	80	
95191	123500	28.5986	80.6817	6					
95191	123500	28.5986	80.6817	30	230	6.0	8.0		
95191	123500	28.6160	80.6930	6				82	73
95191	123500	28.6160	80.6930	30	227	6.0	8.9		
95191	123500	28.6307	80.7027	6					
95191	123500	28.6307	80.7027	30	216	6.0	8.9		
95191	123500	28.6431	80.7482	6				81	
95191	123500	28.6431	80.7482	12	229	2.9	7.0		
95191	123500	28.6431	80.7482	54	225	6.0	8.9	81	
95191	123500	28.4632	80.6702	6				81	
95191	123500	28.4632	80.6702	12	217	1.9	5.1		
95191	123500	28.4632	80.6702	54	212	2.9	7.0	80	
95191	123500	28.5184	80.6962	6				80	
95191	123500	28.5184	80.6962	12	228	1.9	6.0		
95191	123500	28.5184	80.6962	54	217	4.1	7.0	80	
95191	123500	28.7464	80.8707	6					
95191	123500	28.7464	80.8707	54					
95191	123500	28.4079	80.7604	6					
95191	123500	28.4079	80.7604	54					
95191	123500	28.5272	80.7742	6				81	75
95191	123500	28.5272	80.7742	54	217	5.1	7.0		

METEOROLOGICAL TOWER DATA AT 12:35:00 ZULU TIME (T - 3 minutes) (continued)

DAY	TIME	LAT	LON	Z	DIR	SPD	PSPD	T	TD
95191	123500	28.6294	80.6235	6					73
95191	123500	28.6294	80.6235	60	217	5.1	7.0	81	
95191	123500	28.6248	80.6182	6				82	73
95191	123500	28.6248	80.6182	60	219	6.0	8.0	82	
95191	123500	28.4586	80.5923	6				81	
95191	123500	28.4586	80.5923	12	230	4.1	6.0		
95191	123500	28.4586	80.5923	54	226	4.1	7.0	80	
95191	123500	28.6062	80.6739	6				81	
95191	123500	28.6062	80.6739	12	235	2.9	6.0		
95191	123500	28.6062	80.6739	54	230	4.1	8.0	80	
95191	123500	28.6586	80.6998	6				80	
95191	123500	28.6586	80.6998	12	224	1.9	6.0		
95191	123500	28.6586	80.6998	54	221	4.1	7.0	81	
95191	123500	28.7055	80.7265	6				82	75
95191	123500	28.7055	80.7265	54	206	2.9	6.0		
95191	123500	28.7755	80.8043	6					
95191	123500	28.7755	80.8043	54					
95191	123500	28.5158	80.6400	6				80	
95191	123500	28.5158	80.6400	12	222	4.1	6.0		
95191	123500	28.5158	80.6400	54	240	4.1	7.0	80	
95191	123500	28.5623	80.6694	6				81	
95191	123500	28.5623	80.6694	12	256	4.1	7.0		
95191	123500	28.5623	80.6694	54	240	5.1	8.0	80	
95191	123500	28.5986	80.6817	6					
95191	123500	28.5986	80.6817	30	230	6.0	8.0		
95191	123500	28.6160	80.6930	6				82	73
95191	123500	28.6160	80.6930	30	227	6.0	8.9		
95191	123500	28.6307	80.7027	6					
95191	123500	28.6307	80.7027	30	216	6.0	8.9		
95191	123500	28.6431	80.7482	6				81	
95191	123500	28.6431	80.7482	12	229	2.9	7.0		
95191	123500	28.6431	80.7482	54	225	6.0	8.9	81	
95191	123500	28.4632	80.6702	6				81	
95191	123500	28.4632	80.6702	12	217	1.9	5.1		
95191	123500	28.4632	80.6702	54	212	2.9	7.0	80	
95191	123500	28.5184	80.6962	6				80	
95191	123500	28.5184	80.6962	12	228	1.9	6.0		
95191	123500	28.5184	80.6962	54	217	4.1	7.0	80	
95191	123500	28.7464	80.8707	6					
95191	123500	28.7464	80.8707	54					
95191	123500	28.4079	80.7604	6					
95191	123500	28.4079	80.7604	54					
95191	123500	28.5272	80.7742	6				81	75
95191	123500	28.5272	80.7742	54	217	5.1	7.0		

METEOROLOGICAL TOWER DATA AT 12:35:00 ZULU TIME(T - 3 minutes)
(continued)

DAY	TIME	LAT	LON	Z	DIR	SPD	PSPD	T	TD
95191	123500	28.3932	80.8211	6				80	76
95191	123500	28.3932	80.8211	54	210	1.9	5.1		
95191	123500	28.3382	80.7321	6				81	77
95191	123500	28.3382	80.7321	54	222	1.9	4.1		

METEOROLOGICAL TOWER DATA AT 13:00:00 ZULU TIME (T + 22 minutes)

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
95191	130000	28.4338	80.5734	6			85	
95191	130000	28.4338	80.5734	12	220	4.1		
95191	130000	28.4338	80.5734	54	233	7.0	81	
95191	130000	28.4598	80.5267	6			83	
95191	130000	28.4598	80.5267	12	255	5.1		
95191	130000	28.4598	80.5267	54	247	7.0	82	
95191	130000	28.4466	80.5652	6				
95191	130000	28.7435	80.7005	6				
95191	130000	28.7435	80.7005	54				
95191	130000	28.7975	80.7378	6			83	75
95191	130000	28.7975	80.7378	54	250	8.0		
95191	130000	28.4721	80.5393	6				
95191	130000	28.4721	80.5393	90	224	6.0		
95191	130000	28.5622	80.5785	6				
95191	130000	28.5622	80.5785	54	184	0.0		
95191	130000	28.5836	80.5842	6				
95191	130000	28.5836	80.5842	54	213	4.1		
95191	130000	28.5130	80.5613	6			83	77
95191	130000	28.5130	80.5613	12	223	1.9		
95191	130000	28.5130	80.5613	54	227	4.1	82	
95191	130000	28.5130	80.5613	162	223	6.0		
95191	130000	28.5130	80.5613	204	217	6.0	81	
95191	130000	28.5130	80.5613	6			82	75
95191	130000	28.5130	80.5613	12	223	1.9		
95191	130000	28.5130	80.5613	54	226	5.1	82	
95191	130000	28.5130	80.5613	162	225	6.0		
95191	130000	28.5130	80.5613	204	225	6.0	80	
95191	130000	28.5358	80.5747	6			82	
95191	130000	28.5358	80.5747	12	236	4.1		
95191	130000	28.5358	80.5747	54	227	5.1	81	
95191	130000	28.6141	80.6203	6			82	
95191	130000	28.6141	80.6203	12	223	4.1		
95191	130000	28.6141	80.6203	54	219	5.1	81	
95191	130000	28.4048	80.6519	6			82	76
95191	130000	28.4048	80.6519	54	241	7.0		
95191	130000	28.4600	80.5711	6			83	
95191	130000	28.4600	80.5711	12	223	1.9		
95191	130000	28.4600	80.5711	54	224	5.1	81	
95191	130000	28.6027	80.6414	6			82	
95191	130000	28.6027	80.6414	12	225	2.9		
95191	130000	28.6027	80.6414	54	224	5.1	81	
95191	130000	28.6105	80.6069	6				73
95191	130000	28.6105	80.6069	60	204	6.0	83	
95191	130000	28.6057	80.6016	6			83	76
95191	130000	28.6057	80.6016	60	213	6.0	82	

METEOROLOGICAL TOWER DATA AT 13:00:00 ZULU TIME (T + 22 minutes) (Continued)

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
95191	130000	28.6294	80.6235	6				73
95191	130000	28.6294	80.6235	60	207	7.0	82	
95191	130000	28.6248	80.6182	6			83	73
95191	130000	28.6248	80.6182	60	220	7.0	83	
95191	130000	28.4586	80.5923	6			82	
95191	130000	28.4586	80.5923	12	229	5.1		
95191	130000	28.4586	80.5923	54	226	5.1	81	
95191	130000	28.6062	80.6739	6			82	
95191	130000	28.6062	80.6739	12	226	4.1		
95191	130000	28.6062	80.6739	54	224	6.0	81	
95191	130000	28.6586	80.6998	6			82	
95191	130000	28.6586	80.6998	12	242	1.9		
95191	130000	28.6586	80.6998	54	241	4.1	82	
95191	130000	28.7055	80.7265	6			83	74
95191	130000	28.7055	80.7265	54	225	4.1		
95191	130000	28.7755	80.8043	6			83	78
95191	130000	28.7755	80.8043	54	245	8.0		
95191	130000	28.5158	80.6400	6			82	
95191	130000	28.5158	80.6400	12	213	4.1		
95191	130000	28.5158	80.6400	54	222	4.1	81	
95191	130000	28.5623	80.6694	6			83	
95191	130000	28.5623	80.6694	12	234	5.1		
95191	130000	28.5623	80.6694	54	230	7.0	81	
95191	130000	28.5986	80.6817	6				
95191	130000	28.5986	80.6817	30	228	8.0		
95191	130000	28.6160	80.6930	6			83	74
95191	130000	28.6160	80.6930	30	233	7.0		
95191	130000	28.6307	80.7027	6				
95191	130000	28.6307	80.7027	30	217	7.0		
95191	130000	28.6431	80.7482	6			83	
95191	130000	28.6431	80.7482	12	244	1.9		
95191	130000	28.6431	80.7482	54	241	5.1	82	
95191	130000	28.4632	80.6702	6			82	
95191	130000	28.4632	80.6702	12	228	2.9		
95191	130000	28.4632	80.6702	54	216	5.1	82	
95191	130000	28.5184	80.6962	6			82	
95191	130000	28.5184	80.6962	12	227	1.9		
95191	130000	28.5184	80.6962	54	212	2.9	81	
95191	130000	28.7464	80.8707	6				
95191	130000	28.7464	80.8707	54				
95191	130000	28.4079	80.7604	6			81	77
95191	130000	28.4079	80.7604	54	224	5.1		
95191	130000	28.5272	80.7742	6			82	75
95191	130000	28.5272	80.7742	54	229	8.0		

METEOROLOGICAL TOWER DATA AT 13:00:00 ZULU TIME (T + 22 minutes) (Continued)

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
95191	130000	28.6056	80.8248	6				
95191	130000	28.6056	80.8248	54				
95191	130000	28.5697	80.5864	6			83	76
95191	130000	28.5697	80.5864	12	216	2.9		
95191	130000	28.5697	80.5864	54	219	6.0	82	
95191	130000	28.5697	80.5864	162	223	6.0		
95191	130000	28.5697	80.5864	204	220	6.0	81	
95191	130000	28.5697	80.5864	6			83	78
95191	130000	28.5697	80.5864	12	227	2.9		
95191	130000	28.5697	80.5864	54	224	6.0	82	
95191	130000	28.5697	80.5864	162	225	6.0		
95191	130000	28.5697	80.5864	204	225	7.0	81	
95191	130000	28.4843	80.7856	6			83	76
95191	130000	28.4843	80.7856	54	236	5.1		
95191	130000	28.6445	80.9034	6				
95191	130000	28.4114	80.9284	6				
95191	130000	28.4114	80.9284	54				
95191	130000	28.4475	80.8538	6				
95191	130000	28.4960	80.8843	6			81	78
95191	130000	28.4960	80.8843	54	206	4.1		
95191	130000	28.5583	80.9132	6				
95191	130000	28.6173	80.9581	6			82	76
95191	130000	28.6173	80.9581	54	227	4.1		
95191	130000	28.6762	80.9987	6				
95191	130000	28.6762	80.9987	54				
95191	130000	28.5231	81.0100	6			82	76
95191	130000	28.5231	81.0100	54	226	5.1		
95191	130000	28.6489	81.0693	6			90	83
95191	130000	28.6489	81.0693	54	217	4.1		
95191	130000	28.4417	81.0291	6			81	76
95191	130000	28.4417	81.0291	54	212	4.1		
95191	130000	28.6256	80.6571	6			83	74
95191	130000	28.6256	80.6571	12	229	1.9		
95191	130000	28.6256	80.6571	54	232	6.0	82	
95191	130000	28.6256	80.6571	162	233	7.0		
95191	130000	28.6256	80.6571	204	234	6.0	81	
95191	130000	28.6256	80.6571	295	235	7.0		
95191	130000	28.6256	80.6571	394	231	7.0		
95191	130000	28.6256	80.6571	492	228	7.0	80	
95191	130000	28.6256	80.6571	6			83	76
95191	130000	28.6256	80.6571	12	228	1.9		
95191	130000	28.6256	80.6571	54	232	7.0	82	
95191	130000	28.6256	80.6571	162	229	8.9		
95191	130000	28.6256	80.6571	204	237	8.9	81	
95191	130000	28.6256	80.6571	295	233	8.9		
95191	130000	28.6256	80.6571	394	238	8.9		
95191	130000	28.6256	80.6571	492	234	8.9	79	

METEOROLOGICAL TOWER DATA AT 13:00:00 ZULU TIME (T + 22 minutes) (Continued)

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
95191	130000	28.3932	80.8211	6			81	76
95191	130000	28.3932	80.8211	54	217	1.9		
95191	130000	28.3382	80.7321	6			83	77
95191	130000	28.3382	80.7321	54	237	2.9		

METEOROLOGICAL TOWER DATA AT 14:00:00 ZULU TIME (T + 1 hour and 22 minutes)

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
95191	140000	28.4338	80.5734	6			88	
95191	140000	28.4338	80.5734	12	218	5.1		
95191	140000	28.4338	80.5734	54	233	8.0	84	
95191	140000	28.4598	80.5267	6			84	
95191	140000	28.4598	80.5267	12	227	6.0		
95191	140000	28.4598	80.5267	54	223	7.0	82	
95191	140000	28.4466	80.5652	6				
95191	140000	28.7435	80.7005	6			85	76
95191	140000	28.7435	80.7005	54	241	8.0		
95191	140000	28.7975	80.7378	6			86	75
95191	140000	28.7975	80.7378	54	237	8.9		
95191	140000	28.4721	80.5393	6				
95191	140000	28.4721	80.5393	90	249	7.0		
95191	140000	28.5622	80.5785	6				
95191	140000	28.5622	80.5785	54	183	0.0		
95191	140000	28.5836	80.5842	6				
95191	140000	28.5836	80.5842	54	216	6.0		
95191	140000	28.5130	80.5613	6			84	78
95191	140000	28.5130	80.5613	12	231	2.9		
95191	140000	28.5130	80.5613	54	231	5.1	83	
95191	140000	28.5130	80.5613	162	233	8.0		
95191	140000	28.5130	80.5613	204	228	8.0	82	
95191	140000	28.5130	80.5613	6			84	75
95191	140000	28.5130	80.5613	12	230	2.9		
95191	140000	28.5130	80.5613	54	228	6.0	83	
95191	140000	28.5130	80.5613	162	236	8.0		
95191	140000	28.5130	80.5613	204	237	8.0	82	
95191	140000	28.5358	80.5747	6			84	
95191	140000	28.5358	80.5747	12	236	5.1		
95191	140000	28.5358	80.5747	54	228	7.0	83	
95191	140000	28.6141	80.6203	6			84	
95191	140000	28.6141	80.6203	12	246	5.1		
95191	140000	28.6141	80.6203	54	243	7.0	83	
95191	140000	28.4048	80.6519	6			83	77
95191	140000	28.4048	80.6519	54	244	9.9		
95191	140000	28.4600	80.5711	6			85	
95191	140000	28.4600	80.5711	12	255	4.1		
95191	140000	28.4600	80.5711	54	243	6.0	83	
95191	140000	28.6027	80.6414	6			84	
95191	140000	28.6027	80.6414	12	240	4.1		
95191	140000	28.6027	80.6414	54	240	8.9	83	
95191	140000	28.6105	80.6069	6				73
95191	140000	28.6105	80.6069	60	229	7.0	85	
95191	140000	28.6057	80.6016	6			86	76
95191	140000	28.6057	80.6016	60	259	8.0	84	

METEOROLOGICAL TOWER DATA AT 14:00:00 ZULU TIME (T + 1 hour and 22 minutes) (Continued)

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
95191	140000	28.6294	80.6235	6				73
95191	140000	28.6294	80.6235	60	236	8.0	84	
95191	140000	28.6248	80.6182	6			85	73
95191	140000	28.6248	80.6182	60	213	8.9	84	
95191	140000	28.4586	80.5923	6			84	
95191	140000	28.4586	80.5923	12	234	6.0		
95191	140000	28.4586	80.5923	54	228	7.0	83	
95191	140000	28.6062	80.6739	6			83	
95191	140000	28.6062	80.6739	12	222	4.1		
95191	140000	28.6062	80.6739	54	231	6.0	82	
95191	140000	28.6586	80.6998	6			83	
95191	140000	28.6586	80.6998	12	214	4.1		
95191	140000	28.6586	80.6998	54	222	6.0	83	
95191	140000	28.7055	80.7265	6			85	75
95191	140000	28.7055	80.7265	54	228	5.1		
95191	140000	28.7755	80.8043	6			86	79
95191	140000	28.7755	80.8043	54	235	8.0		
95191	140000	28.5158	80.6400	6			84	
95191	140000	28.5158	80.6400	12	241	4.1		
95191	140000	28.5158	80.6400	54	244	5.1	83	
95191	140000	28.5623	80.6694	6			85	
95191	140000	28.5623	80.6694	12	247	4.1		
95191	140000	28.5623	80.6694	54	247	5.1	83	
95191	140000	28.5986	80.6817	6				
95191	140000	28.5986	80.6817	30	230	7.0		
95191	140000	28.6160	80.6930	6			85	74
95191	140000	28.6160	80.6930	30	239	7.0		
95191	140000	28.6307	80.7027	6				
95191	140000	28.6307	80.7027	30	230	8.0		
95191	140000	28.6431	80.7482	6			85	
95191	140000	28.6431	80.7482	12	257	2.9		
95191	140000	28.6431	80.7482	54	249	7.0	83	
95191	140000	28.4632	80.6702	6			84	
95191	140000	28.4632	80.6702	12	224	2.9		
95191	140000	28.4632	80.6702	54	212	6.0	83	
95191	140000	28.5184	80.6962	6			84	
95191	140000	28.5184	80.6962	12	257	4.1		
95191	140000	28.5184	80.6962	54	243	6.0	83	
95191	140000	28.7464	80.8707	6			86	76
95191	140000	28.7464	80.8707	54	250	1.9		
95191	140000	28.4079	80.7604	6			84	77
95191	140000	28.4079	80.7604	54	252	7.0		
95191	140000	28.5272	80.7742	6			84	75
95191	140000	28.5272	80.7742	54	237	7.0		

METEOROLOGICAL TOWER DATA AT 14:00:00 ZULU TIME (T + 1 hour and 22 minutes) (Continued)

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
95191	140000	28.6056	80.8248	6			85	74
95191	140000	28.6056	80.8248	54	257	4.1		
95191	140000	28.5697	80.5864	6			85	76
95191	140000	28.5697	80.5864	12	227	2.9		
95191	140000	28.5697	80.5864	54	233	8.0	84	
95191	140000	28.5697	80.5864	162	236	8.9		
95191	140000	28.5697	80.5864	204	233	8.9	83	
95191	140000	28.5697	80.5864	6			85	77
95191	140000	28.5697	80.5864	12	236	2.9		
95191	140000	28.5697	80.5864	54	237	8.9	83	
95191	140000	28.5697	80.5864	162	237	8.9		
95191	140000	28.5697	80.5864	204	238	9.9	82	
95191	140000	28.4843	80.7856	6			86	76
95191	140000	28.4843	80.7856	54	250	4.1		
95191	140000	28.6445	80.9034	6				
95191	140000	28.4114	80.9284	6			85	77
95191	140000	28.4114	80.9284	54	235	5.1		
95191	140000	28.4475	80.8538	6				
95191	140000	28.4960	80.8843	6			84	77
95191	140000	28.4960	80.8843	54	243	7.0		
95191	140000	28.5583	80.9132	6				
95191	140000	28.6173	80.9581	6			86	76
95191	140000	28.6173	80.9581	54	227	5.1		
95191	140000	28.6762	80.9987	6				
95191	140000	28.6762	80.9987	54				
95191	140000	28.5231	81.0100	6			85	76
95191	140000	28.5231	81.0100	54	232	6.0		
95191	140000	28.6489	81.0693	6			92	79
95191	140000	28.6489	81.0693	54	211	8.0		
95191	140000	28.4417	81.0291	6			87	75
95191	140000	28.4417	81.0291	54	233	5.1		
95191	140000	28.6256	80.6571	6			84	74
95191	140000	28.6256	80.6571	12	253	2.9		
95191	140000	28.6256	80.6571	54	234	5.1	83	
95191	140000	28.6256	80.6571	162	236	6.0		
95191	140000	28.6256	80.6571	204	240	6.0	83	
95191	140000	28.6256	80.6571	295	243	6.0		
95191	140000	28.6256	80.6571	394	242	6.0		
95191	140000	28.6256	80.6571	492	235	5.1	81	
95191	140000	28.6256	80.6571	6			84	77
95191	140000	28.6256	80.6571	12	257	2.9		
95191	140000	28.6256	80.6571	54	237	6.0	83	
95191	140000	28.6256	80.6571	162	235	8.0		
95191	140000	28.6256	80.6571	204	244	8.0	82	
95191	140000	28.6256	80.6571	295	243	8.0		
95191	140000	28.6256	80.6571	394	247	8.0		
95191	140000	28.6256	80.6571	492	239	8.0	80	

METEOROLOGICAL TOWER DATA AT 14:00:00 ZULU TIME (T + 1 hour and 22 minutes) (Continued)

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD
95191	140000	28.3932	80.8211	6			85	76
95191	140000	28.3932	80.8211	54	210	4.1		
95191	140000	28.3382	80.7321	6			87	78
95191	140000	28.3382	80.7321	54	235	5.1		

2. Rawindsonde Data

RAWINSONDE DATA

RS011911138
TEST NBR E7587 WS6 1620

RAWINSONDE MSS/MSS
CAPE CANAVERAL AFS, FLORIDA

11:38 Zulu Time, 10 JUL 95 (T - 1 hour)

ALT GEOMFT	DIR DEG	SPD KTS	SHR /SEC	TEMP DEG C	DPT DEG C	PRESS MBS	RH PCT	ABHUM G/M3	DENSITY G/M3	I/R N	V/S KTS	VPS MBS	PW MM
16	170	3.0	.000	25.1	22.8	1014.80	87	20.17	1173.08	380	677	27.76	0
1000	254	14.6	.025	25.6	20.1	981.02	72	17.07	1133.60	353	677	23.53	6
2000	245	16.0	.005	23.5	17.5	947.65	69	14.63	1103.91	333	674	20.03	10
3000	232	18.0	.007	21.6	15.1	915.18	66	12.60	1074.00	315	672	17.14	14
4000	224	19.5	.005	19.8	13.9	883.61	69	11.75	1043.54	303	669	15.89	18
5000	218	20.0	.003	17.7	13.3	852.94	76	11.38	1014.88	295	667	15.28	22
6000	215	20.2	.002	15.8	10.8	823.09	73	9.75	986.61	279	665	13.00	25
7000	214	19.7	.001	13.7	6.4	794.08	61	7.28	959.93	258	662	9.63	27
8000	216	18.1	.003	12.4	-1.3	765.88	40	4.35	931.76	234	660	5.73	29
9000	218	15.9	.004	11.3	-10.5	738.56	21	2.10	903.39	214	658	2.76	30
10000	221	14.9	.002	9.4	-12.1	712.03	21	1.86	876.82	207	656	2.43	31
11000	226	16.4	.003	7.3	-10.5	686.27	27	2.14	851.23	203	653	2.77	31
12000	228	19.8	.006	5.4	-16.1	661.28	19	1.36	826.34	193	651	1.74	32
13000	228	22.4	.004	4.2	-16.7	637.07	20	1.30	799.31	186	650	1.67	32
14000	228	23.3	.001	1.6	-10.9	613.59	39	2.10	776.88	187	647	2.66	33
15000	226	23.4	.001	-.6	-10.7	590.79	46	2.16	753.84	182	644	2.72	33
16000	225	22.3	.002	-2.2	-14.9	568.69	37	1.54	730.33	173	642	1.93	34
17000	223	19.9	.004	-4.1	-19.2	547.27	30	1.09	707.97	165	640	1.35	34
18000	216	17.1	.006	-6.1	-24.0	526.51	23	.71	686.33	158	637	.88	35
19000	209	15.9	.004	-8.1	-26.2	506.39	22	.59	665.31	152	635	.72	35
20000	212	16.2	.001	-9.4	-30.2	486.91	17	.41	642.94	146	633	.50	35
21000	223	17.2	.006	-11.0	-31.8	468.09	16	.35	621.89	141	631	.42	35
22000	232	19.8	.007	-13.2	-33.6	449.87	16	.30	602.82	136	629	.35	35
23000	237	22.0	.005	-14.6	-29.3	432.23	30	.49	582.22	133	627	.58	35
24000	242	22.0	.004	-17.2	-23.0	415.17	60	.81	564.59	131	624	.96	35
25000	253	22.1	.007	-19.0	-37.6	398.64	18	.21	546.28	123	622	.24	36
26000	260	22.5	.005	-21.2	-39.5	382.64	17	.17	528.91	119	619	.19	36
27000	262	23.4	.002	-23.5	-41.2	367.15	18	.14	512.20	115	616	.16	36
28000	264	24.5	.002	-25.7	-43.0	352.16	18	.12	495.73	111	613	.13	36
29000	265	25.8	.002	-28.4	-44.5	337.64	19	.10	480.52	108	610	.11	36
30000	264	25.4	.001	-31.0	-44.2	323.58	26	.11	465.39	104	607	.12	36
31000	999	999.0	.999	-33.4	-45.2	309.96	29	.09	450.41	101	604	.10	36
32000	999	999.0	.999	-36.1	-48.5	296.77	26	.07	436.19	98	600	.07	36

TERMINATION 32186 GEOPFT 9810 GEOPM 293.1 MBS

RAWINSONDE DATA (continued)

RS011911138
TEST NBR E7587 WS6 1620

RAWINSONDE MSS/MSS
CAPE CANAVERAL AFS, FLORIDA

11:38 Zulu Time, 10 JUL 95 (T - 1 hour)

MANDATORY LEVELS

GEOPFT	DIR	KTS	TEMP	DPT	PRESS	RH
442	255	13	26.2	21.8	1000.0	77
1926	246	16	23.6	17.8	950.0	70
3472	228	19	20.8	14.8	900.0	68
5088	218	20	17.4	13.1	850.0	76
6782	214	20	14.1	7.4	800.0	64
8561	217	17	12.1	-8.0	750.0	24
10443	223	15	8.2	-9.5	700.0	28
12436	228	21	4.8	-17.6	650.0	18
14561	227	23	.2	-9.2	600.0	49
16833	223	20	-3.9	-18.6	550.0	31
19279	209	16	-8.6	-27.7	500.0	20
21938	232	20	-13.2	-33.6	450.0	16
24851	252	22	-18.9	-35.7	400.0	24
28069	265	25	-26.0	-43.2	350.0	18
31658	999	999	-35.6	-47.7	300.0	27

SIGNIFICANT LEVELS

GEOMFT	DIR	KTS	TEMP	DPT	PRESS	IR	RH
16	170	3	25.1	22.8	1014.8	380	87
219	255	13	25.9	23.1	1007.7	380	85
624	255	14	26.5	20.7	993.8	359	71
5024	218	20	17.6	13.3	852.2	295	76
5602	216	20	16.4	11.9	834.9	286	75
6153	214	20	15.5	10.4	818.6	277	72
8400	217	17	12.4	-6.9	754.9	222	25
10102	221	15	9.2	-12.3	709.4	206	20
10666	224	15	7.6	-7.9	694.8	208	32
11755	228	19	5.7	-15.0	667.4	195	21
12913	228	22	4.5	-17.4	639.2	186	18
14675	227	23	.0	-9.0	598.1	185	51
17708	219	18	-5.5	-23.6	532.5	159	22
19623	209	16	-9.0	-29.2	494.2	148	18
20871	221	17	-10.7	-31.5	470.5	141	16
22077	233	20	-13.4	-33.7	448.5	136	16
22693	236	22	-14.0	-34.5	437.6	133	16
23263	238	22	-15.2	-24.9	427.7	133	43
23825	241	22	-16.7	-22.5	418.1	132	60
24430	246	22	-18.4	-24.2	408.0	129	60
25014	253	22	-19.0	-37.9	398.4	123	17
25614	258	22	-20.3	-38.9	388.8	121	17
29671	265	26	-29.9	-44.6	328.2	105	22
31595	999	999	-35.2	-47.2	302.1	99	28
32282	999	999	-36.8	-49.4	293.1	97	25

TERMINATION

RS011910623 95191 0655

RAWINSONDE DATA FROM PRIMARY WINDS SOURCE

TEST NBR E7587 WS2 1710
RAWINSONDE MSS/MSS

CAPE CANAVERAL AFS, FLORIDA

06:23 Zulu Time, 10 JUL 95 (T - 6 hours and 15 minutes)

ALT GEOMFT	DIR DEG	SPD KTS	SHR /SEC	TEMP DEG C	DPT DEG C	PRESS MBS	RH PCT	ABHUM G/M3	DENSITY G/M3	I/R N	V/S KTS	VPS MBS	PW MM
16	220	10.0	.000	26.5	23.0	1013.80	81	20.29	1166.31	379	678	28.05	0
1000	245	17.4	.016	26.7	20.1	980.10	67	16.97	1128.55	351	678	23.47	6
2000	240	14.0	.006	25.4	17.3	946.93	61	14.31	1096.11	329	676	19.72	10
3000	225	14.6	.006	22.8	15.5	914.65	64	12.93	1068.97	315	673	17.66	14
4000	216	16.9	.006	20.4	15.2	883.20	72	12.72	1040.41	308	670	17.23	18
5000	214	18.4	.003	18.5	10.8	852.59	61	9.65	1012.60	284	668	12.99	22
6000	217	19.5	.003	16.0	7.4	822.80	57	7.73	986.63	267	664	10.31	24
7000	223	19.8	.003	13.8	5.3	793.79	56	6.72	959.77	255	662	8.90	27
8000	230	16.5	.007	12.2	-3.6	765.58	33	3.59	932.59	230	659	4.72	28
9000	231	14.3	.004	10.9	-13.5	738.21	17	1.64	904.54	212	657	2.15	29
10000	228	11.6	.005	8.3	-5.7	711.65	36	3.07	879.01	215	655	3.99	29
11000	230	12.5	.002	7.0	-16.6	685.85	17	1.29	852.23	198	653	1.67	30
12000	230	12.6	.000	5.0	-14.5	660.84	24	1.59	826.59	194	651	2.04	30
13000	235	12.6	.002	3.7	-19.2	636.60	17	1.05	800.44	185	649	1.34	31
14000	238	13.7	.002	2.7	-21.9	613.16	14	.83	773.83	178	648	1.05	31
15000	229	15.0	.004	.5	-23.5	590.44	15	.73	751.29	172	645	.92	31
16000	219	16.4	.005	-1.6	-24.7	568.40	15	.65	728.70	167	643	.82	32
17000	214	17.5	.003	-3.6	-25.7	547.03	16	.60	706.52	161	640	.75	32
18000	218	18.0	.002	-5.7	-27.6	526.31	16	.51	685.27	156	638	.63	32
19000	223	18.5	.003	-8.1	-30.1	506.21	15	.41	665.19	151	635	.50	32
20000	224	19.3	.001	-10.3	-31.7	486.70	15	.35	644.85	146	632	.43	32
21000	221	21.7	.005	-11.8	-27.0	467.83	27	.56	623.18	143	630	.68	32
22000	224	20.5	.003	-13.0	-33.2	449.61	16	.31	601.85	136	629	.37	32
23000	232	19.7	.005	-15.3	-35.4	431.97	16	.25	583.40	132	626	.30	32
24000	242	20.5	.006	-17.0	-37.2	414.89	15	.21	564.24	127	624	.25	33
25000	250	21.6	.005	-18.4	-38.7	398.40	15	.18	544.75	123	622	.21	33
26000	254	21.9	.003	-20.8	-40.3	382.44	15	.15	527.94	119	619	.18	33
27000	256	22.4	.001	-22.8	-40.7	366.99	18	.15	510.60	115	617	.17	33
28000	258	23.5	.003	-25.6	-34.5	352.03	43	.28	495.21	112	613	.32	33
29000	258	24.5	.002	-28.0	-32.7	337.53	64	.34	479.52	109	610	.39	33
30000	256	22.8	.003	-30.7	-34.2	323.49	71	.30	464.73	106	607	.33	33
31000	253	19.5	.006	-32.8	-37.6	309.90	62	.21	449.14	102	604	.24	33
32000	250	17.6	.003	-35.5	-39.0	296.74	69	.19	434.83	98	601	.20	33
33000	999	999.0	.999	-37.8	-44.0	284.03	52	.11	420.39	94	598	.12	33

TERMINATION 33391 GEOPFT 10178 GEOPM 277.9 MBS

RS011910753 95191 0853

RAWINSONDE DATA FROM PRIMARY WINDS SOURCE

TEST NBR E7587 WS3 3240

RAWINSONDE MSS/MSS

CAPE CANAVERAL AFS, FLORIDA

07:53 Zulu Time, 10 JUL 95 (T - 4 hours and 45 minutes)

ALT GEOMFT	DIR DEG	SPD KTS	SHR /SEC	TEMP DEG C	DPT DEG C	PRESS MBS	RH PCT	ABHUM G/M3	DENSITY G/M3	I/R N	V/S KTS	VPS MBS	PW MM
16	250	7.0	.000	26.4	24.1	1013.70	87	21.67	1165.74	387	678	29.95	0
1000	252	17.6	.018	26.1	21.7	980.04	77	18.78	1129.47	362	678	25.94	6
2000	244	18.1	.004	24.4	19.3	946.82	73	16.36	1098.46	342	675	22.46	11
3000	231	19.3	.007	22.1	20.0	914.51	88	17.19	1068.69	341	673	23.42	16
4000	219	20.5	.007	20.0	16.4	883.06	80	13.78	1041.09	315	670	18.64	21
5000	215	21.3	.003	17.7	14.6	852.42	82	12.42	1013.50	301	667	16.67	25
6000	215	21.2	.000	15.5	11.9	822.61	79	10.46	986.54	284	664	13.93	28
7000	220	20.0	.004	13.6	8.5	793.62	71	8.41	959.06	265	662	11.13	31
8000	224	14.9	.009	12.4	-.9	765.43	40	4.38	931.06	234	660	5.77	33
9000	222	12.7	.004	11.3	-7.7	738.11	26	2.60	902.48	217	658	3.41	34
10000	220	11.5	.002	9.3	-8.8	711.61	27	2.41	876.19	210	656	3.14	35
11000	224	11.7	.001	7.3	-8.7	685.88	31	2.45	850.38	205	653	3.17	36
12000	231	12.5	.003	5.2	-5.3	660.92	47	3.27	825.17	205	651	4.21	37
13000	236	13.9	.003	4.5	-15.1	636.75	23	1.49	798.09	187	650	1.91	37
14000	232	15.3	.003	2.9	-17.8	613.34	20	1.18	773.29	180	648	1.51	38
15000	224	16.4	.004	.6	-17.6	590.64	24	1.21	750.79	175	645	1.53	38
16000	219	17.0	.002	-1.1	-21.1	568.64	20	.90	727.60	168	643	1.13	38
17000	221	17.0	.001	-3.3	-21.4	547.29	23	.88	705.94	163	641	1.10	39
18000	222	16.8	.001	-5.5	-22.8	526.58	24	.79	684.83	158	638	.97	39
19000	220	16.7	.001	-7.8	-25.3	506.50	23	.63	664.56	152	635	.78	39
20000	217	17.6	.002	-10.3	-26.2	487.00	26	.59	645.01	148	632	.72	39
21000	223	21.2	.007	-12.6	-17.9	468.09	65	1.25	625.15	148	630	1.50	40
22000	230	22.6	.005	-13.5	-30.2	449.80	23	.41	603.34	137	628	.50	40
23000	236	22.7	.004	-15.7	-33.0	432.13	21	.31	584.48	132	626	.37	40
24000	242	20.9	.005	-16.9	-34.9	415.03	19	.26	564.10	127	624	.31	40
25000	244	18.7	.004	-18.8	-25.2	398.52	57	.67	545.50	126	622	.79	40
26000	247	18.9	.001	-21.5	-26.7	382.54	63	.59	529.32	122	619	.68	40
27000	252	21.2	.005	-23.2	-32.3	367.07	44	.36	511.39	116	616	.42	40
28000	255	22.9	.004	-25.4	-37.2	352.10	32	.22	494.97	112	614	.25	41
29000	256	23.6	.001	-28.0	-40.4	337.60	29	.16	479.74	108	610	.18	41
30000	254	23.1	.001	-30.6	-43.7	323.56	26	.11	464.73	104	607	.12	41
31000	249	21.3	.005	-33.1	-45.7	309.96	27	.09	449.84	101	604	.10	41
32000	241	18.6	.006	-36.1	-44.6	296.79	41	.10	436.05	98	600	.11	41
33000	230	16.6	.007	-38.8	-44.4	284.03	55	.11	422.21	95	597	.11	41
34000	217	15.9	.006	-40.8	-47.1	271.70	51	.08	407.33	91	594	.09	41
35000	207	16.7	.005	-43.6	-51.1	259.79	43	.05	394.16	88	591	.05	41
36000	211	17.2	.002	-46.5	-53.8	248.25	43	.04	381.52	85	587	.04	41
37000	222	16.2	.006	-49.0	-56.1	237.11	43	.03	368.55	82	584	.03	41
38000	237	14.5	.007	-50.5	-57.6	226.37	42	.02	354.25	79	582	.02	41
39000	245	14.6	.003	-52.6	-59.7	216.04	42	.02	341.27	76	579	.02	41
40000	249	16.7	.004	-54.4	-61.4	206.08	41	.01	328.18	73	577	.01	41
41000	257	18.0	.005	-56.3	-63.2	196.52	41	.01	315.65	70	574	.01	41
42000	268	17.3	.005	-58.7	-65.6	187.32	40	.01	304.34	68	571	.01	41
43000	270	16.2	.002	-60.4	99.9	178.45	999	99.99	292.19	65	569	.00999	
44000	269	16.6	.001	-61.8	99.9	169.96	999	99.99	280.14	62	567	.00999	
45000	271	18.0	.003	-62.9	99.9	161.82	999	99.99	268.18	60	565	.00999	
46000	277	18.5	.003	-65.1	99.9	154.01	999	99.99	257.83	57	562	.00999	
47000	280	18.0	.002	-66.8	99.9	146.50	999	99.99	247.38	55	560	.00999	
48000	283	17.6	.002	-67.6	99.9	139.33	999	99.99	236.11	53	559	.00999	
49000	293	16.9	.005	-68.8	99.9	132.47	999	99.99	225.82	50	557	.00999	
50000	305	16.6	.006	-67.0	99.9	125.95	999	99.99	212.86	47	560	.00999	
51000	312	15.6	.004	-67.7	99.9	119.77	999	99.99	203.12	45	559	.00999	
52000	316	13.5	.004	-69.0	99.9	113.88	999	99.99	194.32	43	557	.00999	
53000	327	10.0	.007	-67.0	99.9	108.28	999	99.99	182.99	41	560	.00999	
54000	354	8.0	.008	-65.7	99.9	103.00	999	99.99	172.93	39	561	.00999	
55000	41	6.5	.010	-65.2	99.9	98.00	999	99.99	164.18	37	562	.00999	

RAWINSONDE DATA FROM PRIMARY WINDS SOURCE
CAPE CANAVERAL AFS, FLORIDA
07:53 Zulu Time, 10 JUL 95 (T - 4 hours and 45 minutes)
Continued

ALT GEOMFT	DIR DEG	SPD KTS	SHR /SEC	TEMP DEG C	DPT DEG C	PRESS MBS	RH PCT	ABHUM G/M3	DENSITY G/M3	I/R N	V/S KTS	VPS MBS	PW MM
56000	104	7.2	.012	-66.6	99.9	93.23	999	99.99	157.26	35	560		.00999
57000	153	8.6	.011	-67.8	99.9	88.67	999	99.99	150.46	34	559		.00999
58000	198	9.4	.012	-67.0	99.9	84.32	999	99.99	142.51	32	560		.00999
59000	240	8.3	.011	-66.1	99.9	80.21	999	99.99	134.95	30	561		.00999
60000	276	4.1	.009	-66.2	99.9	76.30	999	99.99	128.45	29	561		.00999
61000	46	3.6	.012	-65.6	99.9	72.59	999	99.99	121.83	27	562		.00999
62000	76	6.9	.007	-66.2	99.9	69.06	999	99.99	116.25	26	561		.00999
63000	81	9.2	.004	-66.0	99.9	65.70	999	99.99	110.48	25	561		.00999
64000	76	11.5	.004	-65.0	99.9	62.51	999	99.99	104.62	23	562		.00999
65000	69	15.0	.007	-62.1	99.9	59.51	999	99.99	98.22	22	566		.00999
66000	78	16.9	.005	-61.9	99.9	56.67	999	99.99	93.45	21	567		.00999
67000	999	999.0	.999	-63.4	99.9	53.96	999	99.99	89.60	20	565		.00999

TERMINATION 67293 GEOPFT 20511 GEOPM 52.4 MBS
TROPOPAUSE 49288 FEET 130.55 MB -69.2 C 99.9 C

RS011910923 95191 1024

RAWINSONDE DATA FROM PRIMARY WINDS SOURCE

TEST NBR E7587 WS4 3150
RAWINSONDE MSS/MSS

CAPE CANAVERAL AFS, FLORIDA

09:23 Zulu Time 10 JUL 95 (T - 3 hours and 6 minutes)

ALT GEOMFT	DIR DEG	SPD KTS	SHR /SEC	TEMP DEG C	DPT DEG C	PRESS MBS	RH PCT	ABHUM G/M3	DENSITY G/M3	I/R N	V/S KTS	VPS MBS	PW MM
16	270	5.0	.000	25.0	23.2	1013.80	90	20.73	1171.97	384	677	28.52	0
1000	252	15.4	.018	25.3	21.8	980.04	81	18.91	1132.38	364	677	26.05	6
2000	247	16.6	.003	24.6	15.6	946.76	59	13.19	1099.68	323	675	18.12	11
3000	231	18.7	.009	23.0	14.6	914.44	59	12.18	1068.34	310	673	16.65	15
4000	226	18.4	.003	20.8	12.8	883.02	60	10.92	1039.90	297	670	14.81	18
5000	223	19.4	.002	18.3	11.8	852.42	66	10.29	1012.64	288	668	13.84	21
6000	225	20.2	.002	15.7	9.5	822.62	67	8.94	986.88	274	664	11.91	24
7000	225	19.6	.001	13.6	6.1	793.59	60	7.12	959.82	258	662	9.43	27
8000	223	18.2	.003	12.4	-2.7	765.41	35	3.86	931.31	231	660	5.09	28
9000	221	16.3	.003	11.5	-7.8	738.09	25	2.58	901.92	217	658	3.39	29
10000	221	14.6	.003	9.3	-7.0	711.61	31	2.80	875.85	213	656	3.64	30
11000	220	14.5	.001	7.0	-9.4	685.87	30	2.31	851.45	204	653	2.99	31
12000	219	16.8	.004	4.6	-8.7	660.87	37	2.47	827.49	200	650	3.17	31
13000	220	19.0	.004	4.3	-12.8	636.66	28	1.80	798.46	189	650	2.30	32
14000	222	19.8	.002	2.1	-12.5	613.23	33	1.85	775.05	184	647	2.35	33
15000	222	19.5	.001	.2	-16.9	590.49	26	1.29	751.78	176	645	1.62	33
16000	220	18.6	.002	-2.0	-18.1	568.43	28	1.17	729.69	170	642	1.46	33
17000	217	17.4	.002	-3.8	-20.3	547.04	26	.98	707.05	164	640	1.21	34
18000	217	16.0	.002	-6.2	-21.9	526.29	28	.86	686.23	159	637	1.06	34
19000	218	16.3	.001	-8.4	-25.5	506.16	24	.63	665.65	152	634	.76	34
20000	216	18.1	.003	-10.3	-27.2	486.66	23	.54	644.64	147	632	.66	34
21000	216	19.3	.002	-12.1	-27.3	467.78	27	.54	623.83	143	630	.65	35
22000	222	19.3	.003	-13.7	-29.5	449.51	25	.44	603.44	137	628	.53	35
23000	229	19.2	.004	-15.3	-32.3	431.86	22	.34	583.18	132	626	.40	35
24000	232	18.8	.002	-17.1	-32.9	414.78	24	.32	564.08	128	624	.38	35
25000	238	19.2	.004	-19.2	-25.9	398.27	55	.63	546.02	126	621	.74	35
26000	251	20.7	.008	-21.4	-34.7	382.28	29	.27	528.78	120	619	.32	35
27000	258	19.5	.004	-23.6	-37.7	366.80	26	.20	511.93	115	616	.23	35
28000	259	18.3	.002	-26.0	-38.9	351.81	28	.18	495.74	112	613	.21	35
29000	261	19.3	.002	-28.6	-40.8	337.29	30	.15	480.34	108	610	.17	35
30000	263	21.7	.004	-30.6	-42.9	323.24	29	.12	464.26	104	607	.14	35
31000	263	22.4	.001	-33.1	-44.8	309.66	30	.10	449.41	101	604	.11	36
32000	256	21.5	.005	-36.2	-46.9	296.50	32	.08	435.87	98	600	.09	36
33000	248	20.5	.005	-38.5	-49.8	283.76	29	.06	421.27	94	597	.06	36
34000	238	20.3	.006	-40.8	-50.9	271.45	32	.05	406.93	91	594	.05	36
35000	234	20.2	.003	-43.5	-52.8	259.54	34	.04	393.66	88	591	.04	36
36000	234	19.9	.001	-46.0	-55.1	248.04	35	.03	380.44	85	587	.03	36
37000	240	18.7	.004	-48.6	-57.4	236.92	35	.02	367.58	82	584	.02	36
38000	248	17.8	.004	-51.1	-59.6	226.19	35	.02	354.83	79	581	.02	36
39000	254	18.3	.004	-53.0	-61.2	215.84	35	.01	341.48	76	578	.02	36
40000	260	19.4	.004	-53.8	-62.0	205.91	35	.01	327.00	73	577	.01	36
41000	271	19.1	.006	-56.4	-64.4	196.37	35	.01	315.60	70	574	.01	36
42000	275	19.0	.003	-58.5	-66.3	187.17	35	.01	303.71	68	571	.01	36
43000	276	20.9	.003	-59.8	99.9	178.33	999	99.99	291.26	65	569	.01999	
44000	281	23.1	.005	-60.8	99.9	169.87	999	99.99	278.65	62	568	.00999	
45000	293	23.0	.008	-62.7	99.9	161.76	999	99.99	267.80	60	565	.00999	
46000	300	20.2	.006	-64.8	99.9	153.96	999	99.99	257.38	57	563	.00999	
47000	303	16.4	.007	-66.7	99.9	146.46	999	99.99	247.14	55	560	.00999	
48000	302	13.1	.005	-68.1	99.9	139.28	999	99.99	236.70	53	558	.00999	
49000	314	11.6	.005	-68.5	99.9	132.42	999	99.99	225.42	50	558	.00999	
50000	332	11.6	.006	-66.4	99.9	125.94	999	99.99	212.24	47	560	.00999	
51000	345	11.1	.004	-67.9	99.9	119.77	999	99.99	203.26	45	559	.00999	
52000	360	8.8	.006	-66.7	99.9	113.90	999	99.99	192.18	43	560	.00999	
53000	17	8.0	.004	-65.7	99.9	108.35	999	99.99	181.92	41	561	.00999	
54000	30	8.8	.004	-65.0	99.9	103.10	999	99.99	172.59	38	562	.00999	

RAWINSONDE DATA FROM PRIMARY WINDS SOURCE
CAPE CANAVERAL AFS, FLORIDA
09:23 Zulu Time 10 JUL 95 (T - 3 hours and 6 minutes)
Continued

ALT GEOMFT	DIR DEG	SPD KTS	SHR /SEC	TEMP DEG C	DPT DEG C	PRESS MBS	RH PCT	ABHUM G/M3	DENSITY G/M3	I/R N	V/S KTS	VPS MBS	PW MM
55000	41	7.1	.004	-66.2	99.9	98.08	999	99.99	165.12	37	561		.00999
56000	66	2.4	.008	-66.5	99.9	93.30	999	99.99	157.31	35	560		.00999
57000	234	3.3	.010	-68.6	99.9	88.72	999	99.99	151.09	34	558		.00999
58000	262	7.6	.008	-69.0	99.9	84.35	999	99.99	143.92	32	557		.00999
59000	290	10.0	.008	-67.0	99.9	80.20	999	99.99	135.53	30	560		.00999
60000	324	7.5	.010	-66.6	99.9	76.28	999	99.99	128.67	29	560		.00999
61000	32	5.1	.012	-64.9	99.9	72.58	999	99.99	121.43	27	562		.00999
62000	87	7.4	.010	-65.5	99.9	69.06	999	99.99	115.85	26	562		.00999
63000	105	10.2	.007	-65.2	99.9	65.72	999	99.99	110.09	25	562		.00999
64000	102	12.9	.005	-65.3	99.9	62.53	999	99.99	104.81	23	562		.00999
65000	92	16.0	.007	-64.3	99.9	59.51	999	99.99	99.28	22	563		.00999
66000	999	999.0	.999	-63.8	99.9	56.64	999	99.99	94.26	21	564		.00999

TERMINATION 66304 GEOPFT 20209 GEOPM 55.0 MBS
TROPOPAUSE 48846 FEET 133.45 MB -69.2 C 99.9 C

RS011911033 95191 1134

RAWINSONDE DATA FROM PRIMARY WINDS SOURCE

TEST NBR 37587 WS5 3060
RAWINSONDE MSS/MSS

CAPE CANAVERAL AFS, FLORIDA

10:33 Zulu Time 10 JUL 95 (T - 2 hours and 5 minutes)

ALT GEOMFT	DIR DEG	SPD KTS	SHR /SEC	TEMP DEG C	DPT DEG C	PRESS MBS	RH PCT	ABHUM G/M3	DENSITY G/M3	I/R N	V/S KTS	VPS MBS	PW MM
16	240	3.0	.000	23.9	22.7	1014.30	93	20.13	1177.31	382	675	27.59	0
1000	251	12.8	.017	25.5	20.5	980.49	74	17.49	1132.96	356	677	24.11	6
2000	240	16.4	.008	24.5	15.5	947.17	58	12.92	1100.74	322	675	17.75	11
3000	225	18.5	.008	22.6	15.9	914.81	66	13.24	1069.66	317	673	18.06	14
4000	216	18.3	.005	20.2	15.4	883.34	74	12.92	1041.33	310	670	17.49	18
5000	213	18.8	.002	17.8	13.5	852.70	76	11.56	1013.86	296	667	15.52	22
6000	214	19.1	.001	15.4	11.5	822.88	78	10.23	987.22	282	664	13.63	25
7000	219	18.5	.003	13.8	5.7	793.87	58	6.95	959.42	256	662	9.20	28
8000	225	16.9	.004	12.5	-4.0	765.67	32	3.56	931.62	229	660	4.69	30
9000	232	15.3	.004	11.4	-10.9	738.34	20	2.03	902.88	214	658	2.66	30
10000	238	14.7	.003	9.4	-10.7	711.83	23	2.09	876.43	208	656	2.72	31
11000	234	15.0	.002	6.9	-10.3	686.08	28	2.16	852.03	203	653	2.79	32
12000	226	17.6	.006	4.9	-13.1	661.06	26	1.74	827.11	195	650	2.23	32
13000	225	20.7	.005	4.2	-15.7	636.84	22	1.43	799.08	187	650	1.83	33
14000	230	23.2	.005	1.7	-11.9	613.39	35	1.93	776.28	185	647	2.45	33
15000	233	23.4	.002	-.8	-13.5	590.59	37	1.72	754.33	179	644	2.16	34
16000	232	22.1	.002	-2.6	-16.0	568.47	36	1.45	731.00	172	642	1.81	34
17000	227	20.0	.004	-4.1	-23.1	547.05	21	.77	707.96	163	640	.95	34
18000	220	18.2	.005	-6.3	-23.1	526.28	25	.77	686.70	158	637	.95	35
19000	209	17.5	.006	-8.2	-24.1	506.16	26	.71	665.18	153	635	.87	35
20000	206	18.5	.002	-10.2	-23.2	486.66	34	.78	644.33	149	632	.95	35
21000	212	19.6	.004	-11.7	-31.3	467.79	18	.37	623.08	141	630	.44	35
22000	223	20.9	.007	-12.6	-33.0	449.57	16	.31	600.97	136	629	.37	35
23000	235	22.0	.007	-14.1	-33.5	431.99	18	.30	580.86	131	627	.36	36
24000	245	22.4	.007	-16.7	-25.5	414.97	46	.64	563.43	130	624	.76	36
25000	255	23.2	.007	-18.8	-30.3	398.46	37	.44	545.51	125	622	.52	36
26000	260	24.0	.004	-20.9	-38.4	382.49	19	.19	528.11	119	619	.22	36
27000	261	24.8	.002	-23.3	-40.3	367.02	19	.15	511.65	115	616	.18	36
28000	261	26.1	.002	-25.7	-42.0	352.05	20	.13	495.46	111	613	.15	36
29000	262	27.5	.003	-28.1	-44.2	337.54	20	.10	479.76	108	610	.12	36
30000	262	27.3	.000	-30.9	-46.0	323.49	21	.09	465.12	104	607	.10	36
31000	258	25.9	.003	-33.7	-47.7	309.87	23	.07	450.82	101	603	.08	36
32000	253	24.4	.005	-36.3	-49.4	296.68	24	.06	436.37	98	600	.06	36
33000	249	23.2	.004	-38.7	-49.7	283.92	30	.06	421.88	94	597	.06	36
34000	246	21.6	.003	-41.1	-50.2	271.58	36	.06	407.73	91	594	.06	36
35000	244	20.1	.003	-43.8	-52.2	259.67	38	.04	394.34	88	590	.05	36
36000	244	19.3	.001	-46.3	-54.4	248.14	39	.03	381.11	85	587	.04	36
37000	245	19.1	.001	-48.6	-56.4	237.02	39	.03	367.75	82	584	.03	36
38000	251	18.0	.004	-50.0	-57.8	226.30	39	.02	353.24	79	582	.02	36
39000	261	15.5	.006	-51.8	-59.7	216.00	38	.02	340.03	76	580	.02	36
40000	278	12.8	.008	-53.3	-61.3	206.10	37	.01	326.65	73	578	.02	36
41000	297	12.0	.007	-55.5	-63.3	196.57	36	.01	314.58	70	575	.01	36
42000	310	14.1	.006	-57.9	-65.6	187.39	36	.01	303.23	68	572	.01	36
43000	311	16.7	.004	-60.1	99.9	178.56	999	99.99	291.99	65	569	.00	999
44000	310	17.3	.001	-62.5	99.9	170.04	999	99.99	281.28	63	566	.00	999
45000	308	15.9	.002	-64.5	99.9	161.85	999	99.99	270.28	60	563	.00	999
46000	309	13.6	.004	-65.0	99.9	154.01	999	99.99	257.72	57	562	.00	999
47000	307	13.7	.001	-64.7	99.9	146.55	999	99.99	244.92	55	563	.00	999
48000	305	14.2	.001	-65.8	99.9	139.44	999	99.99	234.26	52	561	.00	999
49000	308	12.8	.003	-66.5	99.9	132.64	999	99.99	223.59	50	560	.00	999
50000	316	10.2	.005	-65.3	99.9	126.18	999	99.99	211.54	47	562	.00	999
51000	331	7.3	.006	-64.0	99.9	120.08	999	99.99	200.00	45	564	.00	999
52000	341	5.6	.003	-64.1	99.9	114.28	999	99.99	190.47	42	564	.00	999
53000	7	4.9	.004	-64.8	99.9	108.76	999	99.99	181.90	41	563	.00	999
54000	39	5.9	.005	-65.6	99.9	103.49	999	99.99	173.69	39	562	.00	999
55000	64	5.5	.004	-64.8	99.9	98.47	999	99.99	164.68	37	563	.00	999

RAWINSONDE DATA FROM PRIMARY WINDS SOURCE
CAPE CANAVERAL AFS, FLORIDA
10:33 Zulu Time 10 JUL 95 (T - 2 hours and 5 minutes)
Continued

ALT GEOMFT	DIR DEG	SPD KTS	SHR /SEC	TEMP DEG C	DPT DEG C	PRESS MBS	RH PCT	ABHUM G/M3	DENSITY G/M3	I/R N	V/S KTS	VPS MBS	PW MM
56000	113	2.8	.007	-66.0	99.9	93.69	999	99.99	157.59	35	561	.00999	
57000	218	3.7	.009	-68.2	99.9	89.11	999	99.99	151.47	34	558	.00999	
58000	266	7.0	.009	-69.3	99.9	84.71	999	99.99	144.76	32	557	.00999	
59000	301	8.7	.008	-68.9	99.9	80.53	999	99.99	137.36	31	557	.00999	
60000	345	5.9	.010	-68.5	99.9	76.56	999	99.99	130.32	29	558	.00999	
61000	50	5.9	.011	-67.0	99.9	72.80	999	99.99	123.01	27	560	.00999	
62000	86	8.4	.009	-66.4	99.9	69.25	999	99.99	116.70	26	560	.00999	
63000	91	10.7	.004	-65.3	99.9	65.88	999	99.99	110.45	25	562	.00999	
64000	87	14.7	.007	-63.3	99.9	62.70	999	99.99	104.09	23	565	.00999	
65000	86	20.1	.009	-61.1	99.9	59.71	999	99.99	98.08	22	568	.00999	
66000	999	999.0	.999	-60.9	99.9	56.87	999	99.99	93.36	21	568	.00999	
67000	999	999.0	.999	-60.6	99.9	54.17	999	99.99	88.77	20	568	.00999	

TERMINATION 66771 GEOPFT 20352 GEOPM 54.0 MBS
TROPOPAUSE 45242 FEET 159.92 MB -65.0 C 99.9 C

RS011911138 95191 1209

RAWINSONDE DATA FROM PRIMARY WINDS SOURCE

TEST NBR E7587 WS6 1620
RAWINSONDE MSS/MSS

CAPE CANAVERAL AFS, FLORIDA

11:38 Zulu Time, 10 JUL 95 (T - 1 hour)

ALT GEOMFT	DIR DEG	SPD KTS	SHR /SEC	TEMP DEG C	DPT DEG C	PRESS MBS	RH PCT	ABHUM G/M3	DENSITY G/M3	I/R N	V/S KTS	VPS MBS	PW MM
16	170	3.0	.000	25.1	22.8	1014.80	87	20.17	1173.08	380	677	27.76	0
1000	254	14.6	.025	25.6	20.1	981.02	72	17.07	1133.60	353	677	23.53	6
2000	245	16.0	.005	23.5	17.5	947.65	69	14.63	1103.91	333	674	20.03	10
3000	232	18.0	.007	21.6	15.1	915.18	66	12.60	1074.00	315	672	17.14	14
4000	224	19.5	.005	19.8	13.9	883.61	69	11.75	1043.54	303	669	15.89	18
5000	218	20.0	.003	17.7	13.3	852.94	76	11.38	1014.88	295	667	15.28	22
6000	215	20.2	.002	15.8	10.8	823.09	73	9.75	986.61	279	665	13.00	25
7000	214	19.7	.001	13.7	6.4	794.08	61	7.28	959.93	258	662	9.63	27
8000	216	18.1	.003	12.4	-1.3	765.88	40	4.35	931.76	234	660	5.73	29
9000	218	15.9	.004	11.3	-10.5	738.56	21	2.10	903.39	214	658	2.76	30
10000	221	14.9	.002	9.4	-12.1	712.03	21	1.86	876.82	207	656	2.43	31
11000	226	16.4	.003	7.3	-10.5	686.27	27	2.14	851.23	203	653	2.77	31
12000	228	19.8	.006	5.4	-16.1	661.28	19	1.36	826.34	193	651	1.74	32
13000	228	22.4	.004	4.2	-16.7	637.07	20	1.30	799.31	186	650	1.67	32
14000	228	23.3	.001	1.6	-10.9	613.59	39	2.10	776.88	187	647	2.66	33
15000	226	23.4	.001	-.6	-10.7	590.79	46	2.16	753.84	182	644	2.72	33
16000	225	22.3	.002	-2.2	-14.9	568.69	37	1.54	730.33	173	642	1.93	34
17000	223	19.9	.004	-4.1	-19.2	547.27	30	1.09	707.97	165	640	1.35	34
18000	216	17.1	.006	-6.1	-24.0	526.51	23	.71	686.33	158	637	.88	35
19000	209	15.9	.004	-8.1	-26.2	506.39	22	.59	665.31	152	635	.72	35
20000	212	16.2	.001	-9.4	-30.2	486.91	17	.41	642.94	146	633	.50	35
21000	223	17.2	.006	-11.0	-31.8	468.09	16	.35	621.89	141	631	.42	35
22000	232	19.8	.007	-13.2	-33.6	449.87	16	.30	602.82	136	629	.35	35
23000	237	22.0	.005	-14.6	-29.3	432.23	30	.49	582.22	133	627	.58	35
24000	242	22.0	.004	-17.2	-23.0	415.17	60	.81	564.59	131	624	.96	35
25000	253	22.1	.007	-19.0	-37.6	398.64	18	.21	546.28	123	622	.24	36
26000	260	22.5	.005	-21.2	-39.5	382.64	17	.17	528.91	119	619	.19	36
27000	262	23.4	.002	-23.5	-41.2	367.15	18	.14	512.20	115	616	.16	36
28000	264	24.5	.002	-25.7	-43.0	352.16	18	.12	495.73	111	613	.13	36
29000	265	25.8	.002	-28.4	-44.5	337.64	19	.10	480.52	108	610	.11	36
30000	264	25.4	.001	-31.0	-44.2	323.58	26	.11	465.39	104	607	.12	36
31000	999	999.0	.999	-33.4	-45.2	309.96	29	.09	450.41	101	604	.10	36
32000	999	999.0	.999	-36.1	-48.5	296.77	26	.07	436.19	98	600	.07	36

TERMINATION 32186 GEOPFT 9810 GEOPM 293.1 MBS
TROPOPAUSE 0 FEET .00 MB .0 C .0 C

RS011911325 95191 1450

RAWINSONDE DATA FROM PRIMARY WINDS SOURCE

TEST NBR E7587 WS7/R3 4740
RAWINSONDE MSS/MSS

CAPE CANAVERAL AFS, FLORIDA

13:25 Zulu Time, 10 JUL 95 (T + 47 minutes)

ALT GEOMFT	DIR DEG	SPD KTS	SHR /SEC	TEMP DEG C	DPT DEG C	PRESS MBS	RH PCT	ABHUM G/M3	DENSITY G/M3	I/R N	V/S KTS	VPS MBS	PW MM
16	250	6.0	.000	29.1	22.7	1015.20	68	19.73	1158.12	373	681	27.52	0
1000	246	11.7	.010	25.9	22.3	981.58	80	19.54	1131.43	367	678	26.97	6
2000	242	15.5	.007	25.0	16.4	948.30	59	13.59	1099.83	325	676	18.70	11
3000	238	16.6	.002	22.8	14.4	915.94	59	12.01	1070.90	310	673	16.41	15
4000	234	16.9	.002	20.5	14.4	884.43	68	12.08	1041.85	305	670	16.37	19
5000	229	18.1	.003	18.4	12.5	853.79	69	10.81	1013.64	291	668	14.54	22
6000	225	20.0	.004	16.8	9.8	824.00	63	9.06	984.65	274	666	12.12	25
7000	223	21.7	.003	14.6	6.5	795.05	59	7.37	958.21	259	663	9.79	28
8000	224	21.5	.001	13.1	-.5	766.90	39	4.47	930.64	235	660	5.91	29
9000	227	19.3	.004	11.5	-6.2	739.57	29	2.94	903.47	219	658	3.87	30
10000	223	17.8	.003	9.8	-8.2	713.05	27	2.52	876.41	211	656	3.29	31
11000	218	19.0	.003	7.1	-3.6	687.30	47	3.64	852.06	213	653	4.70	32
12000	218	22.1	.005	5.9	-12.8	662.30	26	1.89	825.67	196	652	2.43	33
13000	218	24.4	.004	3.9	-8.4	638.07	40	2.54	800.88	195	649	3.24	34
14000	218	24.7	.001	1.7	-6.6	614.57	54	2.94	777.09	192	647	3.73	34
15000	220	22.4	.004	-.2	-11.3	591.76	43	2.06	754.14	181	644	2.59	35
16000	226	18.5	.007	-2.2	-17.0	569.64	31	1.29	731.69	171	642	1.61	36
17000	233	14.2	.008	-3.7	-22.3	548.19	22	.82	708.40	163	640	1.02	36
18000	238	12.2	.004	-5.5	-23.3	527.44	23	.76	685.96	158	638	.93	36
19000	238	12.2	.000	-7.2	-26.0	507.33	21	.60	664.13	152	636	.73	36
20000	243	13.9	.003	-8.9	-28.3	487.88	19	.48	642.96	146	634	.59	37
21000	246	16.9	.005	-11.3	-28.8	469.04	22	.46	623.70	142	631	.56	37
22000	242	20.2	.006	-13.2	-26.0	450.76	33	.61	603.66	139	629	.74	37
23000	238	22.3	.005	-15.1	-21.4	433.09	60	.96	584.14	137	626	1.14	37
24000	240	22.8	.002	-16.8	-34.0	416.00	21	.29	565.10	128	624	.35	37
25000	248	23.3	.006	-19.1	-33.0	399.44	28	.32	547.49	124	621	.38	37
26000	253	24.9	.005	-21.1	-34.6	383.42	28	.28	529.77	120	619	.32	37
27000	256	25.7	.002	-23.7	-37.6	367.89	26	.21	513.66	116	616	.24	38
28000	257	26.1	.001	-26.3	-38.8	352.85	29	.18	497.81	112	613	.21	38
29000	258	25.7	.002	-28.6	-41.0	338.28	29	.15	481.77	108	610	.17	38
30000	261	24.6	.003	-31.1	-42.9	324.17	30	.12	466.51	105	606	.14	38
31000	263	22.3	.004	-33.5	-45.2	310.53	29	.10	451.30	101	604	.11	38
32000	264	20.0	.004	-36.3	-47.2	297.32	31	.08	437.29	98	600	.08	38
33000	269	19.1	.003	-38.6	-50.1	284.54	28	.06	422.56	95	597	.06	38
34000	281	18.5	.007	-41.2	-51.8	272.17	30	.05	408.85	91	594	.05	38
35000	296	18.2	.008	-43.5	-53.5	260.23	31	.04	394.75	88	591	.04	38
36000	312	18.8	.009	-45.6	-55.6	248.70	31	.03	380.70	85	588	.03	38
37000	320	19.8	.005	-47.7	-57.3	237.59	31	.02	367.10	82	585	.03	38
38000	328	20.1	.004	-49.5	-58.9	226.88	32	.02	353.47	79	583	.02	38
39000	334	18.5	.005	-51.8	-61.0	216.57	32	.02	340.79	76	580	.02	38
40000	339	15.7	.005	-53.9	-62.9	206.62	32	.01	328.33	73	577	.01	38
41000	342	12.1	.006	-55.7	-64.4	197.06	32	.01	315.65	70	575	.01	38
42000	342	10.3	.003	-57.7	-66.2	187.85	32	.01	303.70	68	572	.01	38
43000	338	10.5	.001	-60.0	99.9	179.00	999	99.99	292.60	65	569	.00	999
44000	332	11.2	.002	-60.8	99.9	170.49	999	99.99	279.73	62	568	.00	999
45000	313	11.5	.006	-62.9	99.9	162.34	999	99.99	268.95	60	565	.00	999
46000	303	12.7	.004	-62.8	99.9	154.56	999	99.99	256.00	57	565	.00	999
47000	316	12.0	.005	-63.7	99.9	147.14	999	99.99	244.70	55	564	.00	999
48000	323	11.7	.002	-65.1	99.9	140.02	999	99.99	234.43	52	562	.00	999
49000	328	11.8	.002	-66.1	99.9	133.21	999	99.99	224.13	50	561	.00	999
50000	351	12.7	.008	-66.1	99.9	126.72	999	99.99	213.17	47	561	.00	999
51000	10	11.5	.007	-66.3	99.9	120.54	999	99.99	203.03	45	561	.00	999
52000	17	9.2	.004	-66.7	99.9	114.65	999	99.99	193.42	43	560	.00	999
53000	28	7.6	.004	-67.3	99.9	109.04	999	99.99	184.55	41	559	.00	999
54000	64	6.7	.008	-68.0	99.9	103.69	999	99.99	176.06	39	558	.00	999

RS011911325 95191 1450

RAWINSONDE DATA FROM PRIMARY WINDS SOURCE

TEST NBR E7587 WS7/R3 4740
RAWINSONDE MSS/MSS

CAPE CANAVERAL AFS, FLORIDA

13:25 Zulu Time, 10 JUL 95 (T + 47 minutes)

Continued

ALT GEOMFT	DIR DEG	SPD KTS	SHR /SEC	TEMP DEG C	DPT DEG C	PRESS MBS	RH PCT	ABHUM G/M3	DENSITY G/M3	I/R N	V/S KTS	VPS MBS	PW MM
55000	106	9.2	.010	-68.0	99.9	98.59	999	99.99	167.46	37	558		.00999
56000	126	8.5	.005	-67.5	99.9	93.75	999	99.99	158.85	35	559		.00999
57000	123	3.0	.009	-67.8	99.9	89.16	999	99.99	151.23	34	559		.00999
58000	23	4.5	.010	-67.3	99.9	84.79	999	99.99	143.49	32	559		.00999
59000	43	6.5	.005	-67.6	99.9	80.64	999	99.99	136.65	30	559		.00999
60000	83	7.1	.008	-66.8	99.9	76.69	999	99.99	129.45	29	560		.00999
61000	116	9.0	.008	-65.3	99.9	72.96	999	99.99	122.27	27	562		.00999
62000	116	7.7	.002	-64.2	99.9	69.43	999	99.99	115.76	26	563		.00999
63000	89	11.7	.010	-61.7	99.9	66.11	999	99.99	108.93	24	567		.00999
64000	87	19.4	.013	-60.8	99.9	62.97	999	99.99	103.33	23	568		.00999
65000	91	22.9	.006	-62.3	99.9	59.97	999	99.99	99.09	22	566		.00999
66000	95	21.4	.004	-62.3	99.9	57.10	999	99.99	94.36	21	566		.00999
67000	95	20.2	.002	-60.3	99.9	54.38	999	99.99	89.00	20	569		.00999
68000	92	21.8	.003	-59.5	99.9	51.81	999	99.99	84.50	19	570		.00999
69000	91	23.3	.003	-59.4	99.9	49.37	999	99.99	80.48	18	570		.00999
70000	92	22.8	.001	-59.0	99.9	47.04	999	99.99	76.52	17	570		.00999
71000	91	21.2	.003	-57.4	99.9	44.84	999	99.99	72.41	16	573		.00999
72000	86	21.9	.003	-56.9	99.9	42.75	999	99.99	68.86	15	573		.00999
73000	88	22.5	.002	-57.4	99.9	40.75	999	99.99	65.80	15	573		.00999
74000	90	21.3	.002	-57.9	99.9	38.85	999	99.99	62.87	14	572		.00999
75000	83	20.1	.005	-57.4	99.9	37.03	999	99.99	59.78	13	573		.00999
76000	74	22.3	.007	-56.4	99.9	35.31	999	99.99	56.74	13	574		.00999
77000	74	25.7	.006	-56.0	99.9	33.66	999	99.99	54.01	12	574		.00999
78000	77	27.0	.003	-53.0	99.9	32.11	999	99.99	50.82	11	578		.00999
79000	81	28.6	.005	-50.5	99.9	30.65	999	99.99	47.97	11	582		.00999
80000	87	32.0	.008	-49.3	99.9	29.27	999	99.99	45.54	10	583		.00999
81000	94	34.9	.008	-47.5	99.9	27.96	999	99.99	43.16	10	586		.00999
82000	96	36.0	.003	-47.6	99.9	26.71	999	99.99	41.24	9	585		.00999
83000	98	37.9	.004	-48.2	99.9	25.51	999	99.99	39.51	9	585		.00999
84000	101	40.4	.005	-49.3	99.9	24.37	999	99.99	37.93	8	583		.00999
85000	104	40.6	.004	-49.1	99.9	23.27	999	99.99	36.19	8	583		.00999
86000	103	37.2	.006	-48.6	99.9	22.23	999	99.99	34.48	8	584		.00999
87000	99	33.6	.008	-48.9	99.9	21.23	999	99.99	32.98	7	584		.00999
88000	94	33.4	.005	-49.2	99.9	20.27	999	99.99	31.54	7	583		.00999
89000	89	37.3	.008	-49.3	99.9	19.36	999	99.99	30.13	7	583		.00999
90000	86	41.7	.008	-49.5	99.9	18.49	999	99.99	28.80	6	583		.00999
91000	84	43.6	.004	-49.2	99.9	17.66	999	99.99	27.47	6	583		.00999
92000	84	44.2	.001	-48.1	99.9	16.87	999	99.99	26.11	6	585		.00999
93000	88	44.6	.005	-46.2	99.9	16.11	999	99.99	24.74	6	587		.00999
94000	999	999.0	.999	-44.6	99.9	15.40	999	99.99	23.48	5	589		.00999
95000	999	999.0	.999	-44.0	99.9	14.72	999	99.99	22.39	5	590		.00999

TERMINATION 94474 GEOPFT 28796 GEOPM 14.7 MBS
TROPOPAUSE 49386 FEET 130.67 MB -66.7 C 99.9 C

3. Doppler Radar Data

False Cape

Latitude/Longitude 28.60 80.59 3

Date 95 07 10 **Time (hrs., min., secs.)** 12 05 16 0

10

8 7 8 5 5 5 2.0 2.0 2.0

188 188 42 42 700 700 43 43

10.1 10.1 1 1700 1700 32 32 700 700

2 67 272 67

Height (km)	Wind Speed (m/sec)	Wind Dir. (deg.)	Oblique Velocities (m/sec)		Vertical Velocity (m/sec)	# of samples (8 max.)			Signal to Noise Ratio		
0.117	5.7	254	-0.91	1.91	-0.22	7	7	7	13	10	15
0.214	7.8	262	-0.94	2.59	-0.44	8	5	7	11	16	12
0.311	6.5	262	-0.90	2.02	-0.51	7	5	7	10	9	16
0.407	7.9	263	-0.89	2.66	-0.44	7	5	7	11	9	11
0.504	5.4	246	-1.16	1.65	-0.25	8	6	8	16	13	15
0.601	6.0	239	-1.34	1.92	-0.07	8	7	7	14	12	14
0.697	7.3	242	-1.54	2.34	-0.12	8	7	7	11	10	10
0.794	8.3	240	-1.92	2.54	-0.20	7	7	7	9	17	11
0.891	9.6	244	-2.23	2.83	-0.50	8	7	6	3	12	3
0.987	9.8	233	-2.44	2.94	-0.04	8	7	6	-1	7	-2
1.084	9.9	224	-2.71	2.78	0.20	8	7	8	-5	1	-1
1.181	10.1	217	-3.11	2.36	0.14	8	7	8	-4	-3	-5
1.277	9.7	217	-3.12	2.14	-0.01	8	7	8	-8	-6	-1
1.374	10.1	215	-3.30	2.17	0.03	8	7	8	-4	-4	-3
1.471	10.8	214	-3.53	2.29	0.07	8	7	8	-4	-6	-3
1.567	10.8	213	-3.55	2.25	0.06	8	7	8	-5	-9	-8
1.664	10.8	211	-3.65	2.11	0.06	8	7	8	-7	-11	-2
1.760	9.9	213	-3.23	2.08	0.10	8	6	8	-6	-8	-3
1.857	9.9	213	-3.17	2.17	0.16	8	7	8	-4	-7	-4
1.954	10.4	215	-3.27	2.35	0.15	8	7	8	-4	-6	1
2.050	10.4	218	-3.22	2.48	0.09	8	7	8	-2	-5	1
2.147	10.6	218	-3.25	2.53	0.09	8	7	8	-0	-4	-8
2.244	11.5	216	-3.59	2.64	0.16	8	7	8	-1	-6	-1
2.340	10.7	214	-3.36	2.43	0.19	8	7	8	-5	-10	-5
2.437	10.2	216	-3.25	2.29	0.05	8	7	8	-2	-7	-10
2.534	11.0	216	-3.50	2.47	0.08	8	7	8	-4	-8	-11
2.630	9.6	217	-3.06	2.18	0.03	8	7	8	-9	-12	-7
2.727	8.0	220	-2.45	1.92	-0.00	8	5	8	-8	-11	-10
2.824	8.0	225	-2.29	2.12	-7.87	8	6	3	-5	-10	-17
2.920	8.7	228	-2.36	2.43	0.08	8	5	2	-6	-10	-16
3.017	9.7	227	-2.72	2.63	-0.04	8	5	6	-10	-13	-11
3.114	9999.0	9999	-1.94	3.00	0.06	3	3	8	-12	-17	-11

False Cape

Latitude/Longitude 28.60 80.59 3

Date 95 07 10 **Time (hrs., min., secs.)** 12 20 19 0

10

8 7 8 5 5 5 2.0 2.0 2.0

188 188 42 42 700 700 43 43

10.1 10.1 1 1700 1700 32 32 700 700

2 67 272 67

Height (km)	Wind Speed (m/sec)	Wind Dir. (deg.)	Oblique Velocities (m/sec)		Vertical Velocity (m/sec)	# of samples (8 max.)			Signal to Noise Ratio		
0.117	4.6	231	-1.02	1.53	0.18	8	7	7	11	5	10
0.214	5.0	237	-1.01	1.70	0.12	8	7	7	16	11	13
0.311	4.8	234	-0.93	1.68	0.23	8	7	8	11	4	11
0.407	4.9	238	-0.93	1.73	0.15	8	7	7	13	9	12
0.504	5.0	234	-1.02	1.71	0.19	8	7	8	13	11	16
0.601	6.2	237	-1.19	2.16	0.20	8	7	8	17	16	18
0.697	7.1	237	-1.41	2.46	0.21	8	7	8	16	14	17
0.794	8.5	236	-1.76	2.89	0.21	8	7	8	14	13	11
0.891	9.3	235	-1.98	3.13	0.23	8	7	8	8	6	8
0.987	10.3	235	-2.22	3.42	0.25	8	7	8	5	5	1
1.084	10.9	234	-2.42	3.57	0.21	8	7	8	-1	-2	-2
1.181	10.1	227	-2.59	2.98	0.21	8	7	7	-5	-7	-5
1.277	9.7	220	-2.84	2.49	0.16	7	7	8	-7	-6	-5
1.374	10.1	220	-3.04	2.51	0.07	8	7	8	-7	-7	-2
1.471	10.8	213	-3.43	2.35	0.21	8	7	8	-3	-7	-2
1.567	11.3	210	-3.67	2.28	0.24	8	7	8	-2	-8	-6
1.664	11.4	215	-3.75	2.42	0.02	8	5	8	-7	-10	-4
1.760	9.7	216	-3.20	2.06	-0.05	8	7	8	-6	-10	1
1.857	10.0	219	-3.24	2.26	-0.12	8	7	8	-1	-4	-2
1.954	11.0	220	-3.58	2.47	-0.17	8	7	8	0	-2	2
2.050	11.1	224	-3.49	2.62	-0.28	8	7	8	-0	-3	-4
2.147	11.9	224	-3.77	2.77	-0.33	8	7	8	-0	-4	-10
2.244	12.5	221	-3.98	2.89	-0.18	8	7	8	-4	-8	-4
2.340	11.8	222	-3.72	2.75	-0.24	7	7	8	-8	-11	-5
2.437	11.1	221	-3.57	2.55	-0.21	8	7	8	-5	-9	-5
2.534	11.0	221	-3.52	2.50	-0.23	8	7	8	-5	-10	-7
2.630	10.0	216	-3.30	2.11	-0.08	8	7	8	-5	-9	-12
2.727	10.0	215	-3.27	2.14	7.00	8	7	2	-6	-8	-19
2.824	10.0	220	-3.08	2.40	8.71	8	7	3	-9	-12	-18
2.920	9.9	224	-2.90	2.58	9.25	7	5	3	-13	-16	-17
3.017	9999.0	9999	-2.60	-2.70	-0.20	4	3	6	-17	-17	-14
3.114	9999.0	9999	-2.64	-3.09	-0.20	4	3	8	-16	-18	-13

False Cape

Latitude/Longitude 28.60 80.59 3

Date 95 07 10 **Time (hrs., min., secs.)** 12 35 22 0

9

8 7 8 5 5 5 2.0 2.0 2.0

188 188 42 42 700 700 43 43

10.1 10.1 1 1700 1700 32 32 700 700

2 67 272 67

Height (km)	Wind Speed (m/sec)	Wind Dir. (deg.)	Oblique Velocities (m/sec)		Vertical Velocity (m/sec)	# of samples (8 max.)			Signal to Noise Ratio		
0.117	3.9	219	-1.13	1.03	0.12	7	7	8	16	11	18
0.214	4.3	225	-1.19	1.21	0.06	7	7	8	26	18	22
0.311	4.8	223	-1.29	1.34	0.13	7	7	8	17	12	21
0.407	4.6	218	-1.30	1.22	0.18	7	7	8	20	13	22
0.504	5.9	236	-1.28	1.91	0.06	7	7	8	12	9	17
0.601	7.3	242	-1.40	2.50	0.01	8	7	7	15	12	14
0.697	8.2	241	-1.64	2.76	-0.00	8	7	8	12	9	10
0.794	9.0	241	-1.78	3.03	0.01	8	7	8	9	6	8
0.891	9.8	239	-2.05	3.24	0.03	8	7	8	6	4	4
0.987	10.8	238	-2.35	3.50	0.01	8	7	8	0	-1	-5
1.084	10.9	235	-2.53	3.47	0.08	8	7	7	-6	-6	-7
1.181	11.0	231	-2.78	3.26	0.03	8	7	7	-8	-7	-5
1.277	10.3	220	-3.05	2.60	0.13	8	7	8	-5	-6	-5
1.374	10.2	226	-3.04	2.61	-0.17	8	7	7	-5	-6	-11
1.471	9.7	223	-2.86	2.48	-0.00	7	7	7	-5	-7	-10
1.567	10.3	216	-3.02	2.59	0.36	8	7	8	-10	-8	-6
1.664	10.5	221	-3.21	2.54	-0.02	7	7	7	-8	-6	-8
1.760	11.0	222	-3.46	2.62	-0.16	8	7	8	-9	-8	-3
1.857	10.6	223	-3.29	2.58	-0.18	8	7	8	-5	-9	-6
1.954	11.4	224	-3.58	2.73	-0.31	8	7	8	-5	-8	-6
2.050	11.7	224	-3.52	2.94	-0.14	8	7	8	-7	-11	-3
2.147	11.5	224	-3.53	2.81	-0.21	8	7	8	-4	-7	-8
2.244	12.4	223	-3.90	2.95	-0.29	8	7	5	-6	-8	-12
2.340	13.1	223	-4.10	3.11	-0.30	8	7	7	-10	-13	-9
2.437	9999.0	9999	-4.01	3.19	-0.23	7	3	8	-12	-17	-6
2.534	11.0	222	-3.37	2.69	-0.08	8	7	8	-8	-13	-6
2.630	12.1	225	-3.60	3.08	-0.15	8	7	7	-8	-12	-9
2.727	10.2	229	-2.86	2.75	-0.17	8	7	6	-7	-12	-15
2.824	10.2	228	-2.78	2.88	0.21	8	7	3	-7	-11	-19
2.920	10.7	233	-2.90	2.96	-0.31	8	6	5	-11	-12	-16
3.017	9999.0	9999	-2.74	-2.90	-0.14	7	3	8	-15	-18	-10
3.114	9999.0	9999	-1.99	2.96	-0.00	4	4	3	-13	-18	-11

False Cape

Latitude/Longitude 28.60 80.59 3

Date 95 07 10 **Time (hrs., min., secs.)** 12 50 27 0

9

8 7 8 5 5 5 2.0 2.0 2.0

188 188 42 42 700 700 43 43

10.1 10.1 1 1700 1700 32 32 700 700

2 67 272 67

Wind Height (km)	Wind Speed (m/sec)	Dir. (deg.)	Oblique Velocities (m/sec)		Vertical Velocity (m/sec)	# of samples (8 max.)			Signal to Noise Ratio		
0.117	4.9	231	-1.20	1.48	0.04	8	7	7	17	14	18
0.214	4.0	232	-1.13	1.07	-0.14	7	7	8	20	19	23
0.311	5.4	235	-1.30	1.65	-0.04	8	7	7	19	16	20
0.407	4.2	238	-1.03	1.26	-0.11	7	7	8	16	15	18
0.504	6.6	238	-1.36	2.21	0.08	8	7	8	14	14	19
0.601	8.6	242	-1.66	2.97	0.06	8	7	8	18	17	18
0.697	9.6	244	-1.80	3.26	-0.07	8	7	7	12	11	12
0.794	9.5	242	-1.89	3.17	-0.04	8	7	7	9	7	11
0.891	10.1	237	-2.19	3.31	0.09	8	7	7	7	5	5
0.987	10.7	239	-2.37	3.41	-0.08	8	7	8	2	0	1
1.084	10.6	237	-2.48	3.32	-0.10	8	7	8	-1	-3	0
1.181	9.7	230	-2.64	2.73	-0.10	8	7	8	-1	-2	-0
1.277	10.1	228	-2.76	2.82	-0.01	8	7	8	-2	-3	-1
1.374	9.5	228	-2.59	2.64	-0.03	8	7	8	-1	-4	-1
1.471	10.2	228	-2.75	2.86	-0.02	8	7	8	1	-1	-3
1.567	10.4	227	-2.89	2.87	0.01	8	7	8	-2	-5	-5
1.664	10.4	224	-3.00	2.76	0.02	8	7	8	-6	-8	-10
1.760	10.5	216	-3.05	2.64	0.36	8	7	7	-9	-10	-7
1.857	11.1	226	-3.11	3.03	-0.00	8	7	8	-9	-11	-10
1.954	11.3	230	-3.02	3.22	-0.06	8	6	8	-8	-10	-7
2.050	10.3	221	-3.06	2.59	0.05	8	7	8	-7	-10	-5
2.147	10.6	217	-3.25	2.53	0.14	8	7	8	-3	-7	-8
2.244	11.2	219	-3.44	2.67	0.02	8	7	6	-4	-8	-13
2.340	11.8	217	-3.60	2.80	0.20	8	7	8	-7	-11	-8
2.437	11.3	220	-3.43	2.76	0.04	8	6	8	-13	-13	-5
2.534	10.4	226	-2.99	2.76	-0.05	8	7	8	-8	-14	-8
2.630	11.0	224	-3.20	2.85	-8.85	8	7	2	-4	-11	-18
2.727	11.2	221	-3.28	2.86	0.15	8	7	6	-6	-11	-14
2.824	11.3	219	-3.35	2.83	0.20	8	6	7	-11	-12	-13
2.920	9999.0	9999	-2.29	2.66	0.07	5	3	8	-15	-15	-12
3.017	8.5	224	-2.49	2.21	5.99	8	6	3	-14	-13	-18
3.114	9.1	223	-2.68	2.32	-1.59	7	7	2	-14	-13	-18

False Cape

Latitude/Longitude 28.60 80.59 3

Date 95 07 10 **Time (hrs., min., secs.)** 13 05 00 0

10

8 7 8 5 5 5 2.0 2.0 2.0

188 188 42 42 700 700 43 43

10.1 10.1 1 1700 1700 32 32 700 700

2 67 272 67

Height (km)	Wind Speed (m/sec)	Wind Dir. (deg.)	Oblique Velocities (m/sec)		Vertical Velocity (m/sec)	# of samples (8 max.)			Signal to Noise Ratio		
0.117	3.9	243	-0.43	1.64	0.33	7	7	8	22	16	20
0.214	3.7	233	-0.56	1.47	0.37	7	6	8	30	17	24
0.311	3.9	242	-0.47	1.63	0.33	7	7	8	22	19	23
0.407	4.7	246	-0.57	1.86	0.24	7	6	7	27	19	24
0.504	5.6	238	-0.90	2.16	0.37	6	7	8	20	18	17
0.601	7.1	243	-1.29	2.48	0.07	8	7	8	15	14	17
0.697	8.7	244	-1.59	3.00	0.02	8	7	8	15	13	12
0.794	9.2	243	-1.82	3.07	-0.06	8	7	8	10	8	10
0.891	9.7	240	-2.08	3.13	-0.08	8	7	8	6	4	2
0.987	10.4	239	-2.36	3.27	-0.14	8	7	8	-1	-4	-2
1.084	9.9	234	-2.36	3.08	0.03	7	7	8	-4	-9	1
1.181	9.4	232	-2.49	2.70	-0.11	8	7	8	0	-3	-1
1.277	10.0	231	-2.67	2.84	-0.12	8	7	8	-2	-3	-1
1.374	10.1	230	-2.78	2.80	-0.15	8	7	8	-2	-5	-1
1.471	10.5	232	-2.87	2.94	-0.22	8	6	8	-1	-3	-6
1.567	11.2	229	-3.15	3.02	-0.17	8	6	8	-5	-7	-5
1.664	10.9	226	-3.20	2.81	-0.15	8	6	8	-7	-10	-5
1.760	10.9	225	-3.28	2.76	-0.19	8	7	8	-5	-9	-6
1.857	11.3	224	-3.33	2.89	-0.09	8	6	8	-5	-8	-6
1.954	11.7	226	-3.35	3.11	-0.08	8	5	8	-7	-10	-7
2.050	11.2	221	-3.50	2.65	-0.12	8	5	8	-9	-9	-2
2.147	10.7	223	-3.24	2.64	-0.08	8	7	8	-6	-7	-4
2.244	11.6	225	-3.57	2.85	-0.25	8	7	7	-3	-5	-11
2.340	12.5	225	-3.86	3.03	-0.29	8	7	8	-5	-7	-7
2.437	12.0	224	-3.68	2.92	-0.21	8	5	8	-9	-11	-8
2.534	11.8	231	-3.37	3.12	-0.40	8	6	8	-9	-13	-6
2.630	11.6	229	-3.20	3.20	-0.15	8	6	6	-8	-11	-14
2.727	11.5	236	-3.00	3.28	-0.39	8	7	6	-8	-12	-11
2.824	12.1	235	-3.33	3.31	-0.54	8	5	7	-10	-15	-9
2.920	9.7	239	-2.73	2.52	-0.72	7	6	6	-13	-16	-16
3.017	9.8	237	-2.67	2.66	-0.53	8	6	5	-10	-13	-16
3.114	9.7	225	-2.79	2.57	-0.23	8	6	4	-11	-13	-6

False Cape

Latitude/Longitude 28.60 80.59 3

Date 95 07 10 **Time (hrs., min., secs.)** 13 20 11 0

10

8 8 8 5 5 5 2.0 2.0 2.0

188 188 42 42 700 700 43 43

10.1 10.1 1 1700 1700 32 32 700 700

2 67 272 67

Wind Height (km)	Wind Speed (m/sec)	Dir. (deg.)	Oblique Velocities (m/sec)		Vertical Velocity (m/sec)	# of samples (8 max.)			Signal to Noise Ratio		
0.117	9999.0	9999	-0.42	0.94	0.16	6	4	7	15	11	17
0.214	9999.0	9999	-0.71	0.93	0.32	8	3	8	26	16	20
0.311	3.4	232	-0.74	1.10	0.11	7	5	8	18	13	19
0.407	9999.0	9999	-0.45	1.64	0.17	7	4	8	24	17	20
0.504	5.5	249	-0.80	2.02	0.04	8	6	8	22	21	23
0.601	7.0	250	-1.00	2.58	0.03	8	6	8	22	22	23
0.697	8.3	251	-1.20	3.02	-0.01	8	6	8	17	18	14
0.794	9.9	254	-1.25	3.65	-0.03	8	6	8	8	9	5
0.891	10.6	251	-1.57	3.81	-0.07	8	5	8	0	4	-0
0.987	9999.0	9999	-1.95	3.61	0.07	7	4	8	-4	-4	-5
1.084	10.6	239	-2.15	3.59	0.11	7	5	8	-5	-8	-3
1.181	9.3	232	-2.16	2.97	0.18	8	6	8	1	-9	1
1.277	9.3	230	-2.26	2.89	0.21	8	8	8	1	-4	-2
1.374	9.6	230	-2.24	3.05	0.27	8	8	8	-2	-5	-1
1.471	9.6	231	-2.28	3.04	0.23	8	8	8	-3	-6	-5
1.567	10.0	228	-2.43	3.08	0.28	8	8	8	-6	-6	-8
1.664	10.6	229	-2.62	3.21	0.23	8	8	7	-7	-9	-10
1.760	10.9	228	-2.75	3.25	0.21	8	8	7	-9	-11	-6
1.857	10.7	225	-2.91	3.0							